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February 1992

p. 112

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(NASA-SP-7037(275)) AERONAUTICAL
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NASA SP-7037 (275)
February 1992

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES



National Aeronautics and Space Administration
Scientific and Technical Information Program
Washington, DC

1992

INTRODUCTION

This issue of *Aeronautical Engineering—A Continuing Bibliography* (NASA SP-7037) lists 379 reports, journal articles, and other documents originally announced in January 1992 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

Accession numbers cited in this issue are:

STAR (N-10000 Series) N92-10001 — N92-11965
IAA (A-10000 Series) A92-10001 — A92-13248

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number—are included.

A cumulative index for 1992 will be published in early 1993.

Information on availability of documents listed, addresses of organizations, and NTIS price schedules are located at the back of this issue.

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TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED
ON MICROFICHE

ACCESSION NUMBER → **N92-10979*** # United Technologies Research Center, East ← CORPORATE SOURCE
Hartford, CT.

TITLE → **DEVELOPMENT OF UNSTEADY AERODYNAMIC ANALYSES FOR TURBOMACHINERY AEROELASTIC AND AEROACOUSTIC APPLICATIONS**

AUTHORS → **JOSEPH M. VERDON, MARK BARNETT, KENNETH C. HALL, and TIMOTHY C. AYER** Washington NASA Oct. 1991 112 p

CONTRACT NUMBER → (Contract NAS3-25425) ← PUBLICATION DATE

REPORT NUMBERS → (NASA-CR-4405; E-6528; NAS 1.26:4405; R91-957907-3) Avail:

AVAILABILITY SOURCE → NTIS HC/MF A06 CSCL 01/1 ← COSATI CODE

PRICE CODE →

Theoretical analyses and computer codes are being developed for predicting compressible unsteady inviscid and viscous flows through blade rows. Such analyses are needed to determine the impact of unsteady flow phenomena on the structural durability and noise generation characteristics of turbomachinery blading. Emphasis is being placed on developing analyses based on asymptotic representations of unsteady flow phenomena. Thus, flow driven by small-amplitude unsteady excitations in which viscous effects are concentrated in thin layers are being considered. The resulting analyses should apply in many practical situations, lead to a better understanding of the relevant physics, and they will be efficient computationally, and therefore, appropriate for aeroelastic and aeroacoustic design applications. Under the present phase (Task 3), the effort was focused on providing inviscid and viscous prediction capabilities for subsonic unsteady cascade flows.

Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

ACCESSION NUMBER → **A92-13210*** National Aeronautics and Space Administration. ← CORPORATE SOURCE
Ames Research Center, Moffett Field, CA.

TITLE → **PROBE SHAPES FOR STREAMWISE MOMENTUM AND CROSS-STREAM TURBULENCE INTENSITY**

AUTHOR → **VERNON ROSSOW, J.** (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 741-749. refs Copyright ← JOURNAL TITLE

When the highly turbulent flowfields at the edges of jets, in augmentors, and in other jet-mixing devices are surveyed with conventional pitot probes, the values indicated by the instruments may contain a significant increment brought about by the dynamics of the eddies. Although the influence of turbulence on the measurements is usually negligible in streams where the turbulence level is 1 percent or less, the effect of turbulence on static and total pressure measurements can be around 20 percent when the turbulence level exceeds 40 percent. This paper describes a theoretical study that develops probe shapes that directly measure the time-averaged total pressure based on the streamwise component of the velocity vector to obtain a direct measurement of the streamwise momentum. The difference between the time-averaged pressure indicated by such a probe and one that measures the total head based on the entire velocity vector yields the cross-stream turbulence intensity.

Author

AERONAUTICS (GENERAL)

A92-10197

MANUFACTURE OF A PRIMARY FLIGHT STRUCTURE USING THERMOPLASTICS

PIERRE JOUIN, THOMAS LEE (McDonnell Douglas Helicopter Co., Mesa, AZ), and ROBERT VITLIP (ICI Composite Structures, Tempe, AZ) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 1. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1014-1028. refs

Copyright

The application of thermoplastic carbon/PEEK composites to primary airframe structures is demonstrated using the AH-64 Apache Horizontal Stabilizer. Various manufacturing techniques are used including autoclave consolidation, filament winding, and double diaphragm forming. Joining technology centered around bonding with a film of PEI adhesive or with an epoxy film adhesive. Several tool design approaches were tried, from integrally heated ceramic faced tools for the skins to steel press tools with rubber assist for the wing box ribs. O.G.

A92-11001

AIAA INTERNATIONAL BALLOON TECHNOLOGY CONFERENCE, ALBUQUERQUE, NM, OCT. 8-10, 1991, TECHNICAL PAPERS

Washington, DC, American Institute of Aeronautics and Astronautics, 1991, 239 p. For individual items see A92-11002 to A92-11036.

Copyright

Papers presented include a balloon-borne payload for imaging hard X-rays and gamma rays from solar flares, Venus balloons at low altitudes, buoyant kites for planetary exploration, the development of a fracture toughness test for balloon film, and NASA test flights with increased flight stress indices. Also presented are an overpressurized zero pressure balloon system, a feasibility study of an air probe float concept, available techniques for manned orbital balloon flight, the NASA long duration balloon project, and a feasibility study of a balloon-based launch vehicle. R.E.P.

A92-11017#

OPERATIONAL EVALUATION OF RECENTLY DEVELOPED BALLOON FABRICATION METHODS

MICHAEL S. SMITH (Winzen International, Inc., Sulphur Springs, TX) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 101-107. refs

(AIAA PAPER 91-3670) Copyright

The paper describes the development and use of the 'Stable Table' (ST; Rand, 1989) balloon construction method. A detailed explanation of the concept is presented along with advantages and disadvantages. The amount of strain introduced into the balloon seals during production is considered and compared with the

measured properties of currently available balloon construction materials. The resulting strains induced for various sized balloons is calculated and shown to be acceptable for a large variety of sizes. The disadvantages of the production method are described and weighed in comparison to the advantage of decreased change-over time and increased production efficiency. Future plans for production equipment modernization to take full advantage of the ST process are presented. Author

A92-11021#

WHITHER SCIENTIFIC BALLOONING?

J. A. WINKER (Rekwin Co., Sioux Falls, SD) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 143-148. refs

(AIAA PAPER 91-3676) Copyright

Balloons have been used for scientific purposes for almost two centuries (since 1803), and scientific ballooning has been going on for close to a half century. That does not guarantee immortality for this workhorse scientific vehicle. What might cause its demise now? What might assure its continuity? This paper starts off with a simple overview of the progression of balloon capability over the years, particularly during the modern balloon phase. It then examines more carefully the history and trends of the last decade or two. Finally, there is some speculation as to what might become of ballooning in the coming decade or two. Author

A92-11022#

INTERNATIONAL SURVEY OF SCIENTIFIC BALLOONING SUPPORT ORGANIZATIONS

DWIGHT M. BAWCOM (National Scientific Balloon Facility; New Mexico State University, Palestine, TX) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 149-157. refs

(AIAA PAPER 91-3677) Copyright

A survey is presented of worldwide organizations that provide direct balloon flight support to the scientific community. This review assumes the use of zero pressure and superpressure balloons that reach altitudes above the tropopause as well as launch, control, data acquisition, data logging, and recovery of payloads. Focus is on the identity of these organizations, description of their general capabilities, identifying points of contact, and describing their primary areas of interest and scientific support. R.E.P.

A92-11036#

CHINA-SOVIET LONG DURATION BALLOON FLIGHT PROJECT

YIDONG GU, BIN LIU, and LUHUA JIANG (Chinese Academy of Sciences, Institute of High Energy Physics, Beijing, People's Republic of China) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 231-233.

(AIAA PAPER 91-3678) Copyright

In 1989, the Institute of High Energy Physics (IHEP), Academia Sinica, and the Lebedev Physical Institute (LPI), USSR Academy of Sciences, reached an agreement on the six years (1990 to 1995) cooperative project of long duration balloon flight. The

01 AERONAUTICS (GENERAL)

objective of the project is to open an international long distance balloon flight routine in Northern Hemisphere from north China to Tashkent of USSR for 3 to 4 days balloon flights. The first test flight was conducted in July to August, 1990. This year a balloon campaign took place in a new launch site. This paper introduces the campaigns in 1990 and 1991. The technological aspects of the project, progress, and development plan will also be discussed. Author

A92-11181

ORGANIZATIONAL CONTEXT FOR AIRCRAFT MAINTENANCE AND INSPECTION

JAMES C. TAYLOR (Southern California, University, Los Angeles, CA) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1176-1180. Research supported by FAA. refs
Copyright

Improving and maintaining the airworthiness of the aircraft relied on by today's U.S. commercial carriers requires cooperation among organizational entities. A rapid but systematic assessment of maintenance worker interaction, gained by observation and unstructured interviews of air transport maintenance workers during heavy maintenance checks at 7 U.S. air carriers and repair stations, led to several preliminary conclusions. Characteristics of the typical maintenance organization and patterns of cooperation and coordination among structural configurations must be modified to address present and future needs of the aging fleet. Author

A92-13220

SOVIET AEROSPACE IN TURMOIL

JOHN D. MORROCCO Aviation Week and Space Technology (ISSN 0005-2175), vol. 135, Nov. 18, 1991, p. 42-45, 48-55, 57. Copyright

An overview is presented of the changing character of the Soviet commercial and military aerospace industry. The Ministry of Aviation Industry is being dissolved, giving individual research institutes, design bureaus, and manufacturing plants an unprecedented degree of independence. Conversion from military to civil production is accelerating; manufacture of the MiG-29 is terminating; joint ventures are in the planning stages with U.S. and European aerospace companies; five major aerospace research institutes are forming an association intended to lead to the creation of an independent research agency; Tupolev is planning the development of a long-range, twin-engine civil transport; and avionics firms are seeking Western investment as they diversify. R.E.P.

N92-10002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TECHNICAL EVALUATION REPORT, AGARD FLUID DYNAMICS PANEL SYMPOSIUM ON EFFECTS OF ADVERSE WEATHER ON AERODYNAMICS

J. J. REINMANN Oct. 1991 19 p Meeting held in Toulouse, France, 29 Apr. - 1 May 1991
(NASA-TM-105192; E-6460; NAS 1.15:105192) Avail: NTIS HC/MF A03 CSCL 01B

The purpose of the meeting on Effects of Adverse Weather on Aerodynamics was to provide an update of the state-of-the-art with respect to the prediction, simulation, and measurement of the effects of icing, anti-icing fluids, and various precipitation on the aerodynamic characteristics of flight vehicles. Sessions were devoted to introductory and survey papers and icing certification issues, to analytical and experimental simulation of ice frost contamination and its effects of aerodynamics, and to the effects of heavy rain and deicing/anti-icing fluids. Author

N92-10003*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PASSIVE RANGE ESTIMATION FOR ROTORCRAFT LOW-ALTITUDE FLIGHT

B. SRIDHAR, R. SUORSA, and B. HUSSIEN Oct. 1991 37 p

(NASA-TM-103897; A-91242; NAS 1.15:103897) Avail: NTIS HC/MF A03 CSCL 01B

The automation of rotorcraft low-altitude flight presents challenging problems in control, computer vision and image understanding. A critical element in this problem is the ability to detect and locate obstacles, using on-board sensors, and modify the nominal trajectory. This requirement is also necessary for the safe landing of an autonomous lander on Mars. This paper examines some of the issues in the location of objects using a sequence of images from a passive sensor, and describes a Kalman filter approach to estimate the range to obstacles. The Kalman filter is also used to track features in the images leading to a significant reduction of search effort in the feature extraction step of the algorithm. The method can compute range for both straight line and curvilinear motion of the sensor. A laboratory experiment was designed to acquire a sequence of images along with sensor motion parameters under conditions similar to helicopter flight. Range estimation results using this imagery are presented. Author

N92-10972# National Park Service, Washington, DC.

STUDY OF ALTERNATIVES: DAYTON'S AVIATION HERITAGE, OHIO

1991 67 p
(PB91-202275) Avail: NTIS HC/MF A04 CSCL 01/2

Three conceptual alternatives for the preservation, development, and interpretation of aviation-related resources of national, state, and local significance are presented. These alternatives include: (1) West Dayton-- home of a legend; (2) the Wrights as inventors-- catalyst for a world change; and (3) innovation and aviation-- Dayton as a major technological center. A brief preliminary analysis of impacts is also included within each alternative description to aid decision makers in evaluating the study alternatives as to their suitability, feasibility, and environmental consequences. Seven different approaches to implement these alternatives are examined. Focus is on the three nationally significant resources in Dayton, Ohio (the Wright Cycle Company Building, Huffman Prairie Flying Field, and Wright Flyer 3). A limited discussion of the Hoover Block and Hawthorn Hill is presented. The study includes the following information: (1) a general description of resources, including the surrounding urban environment and specific sites and structures designated as National Historical Landmarks; (2) present ownership; (3) existing and proposed uses and their effects on the resources; (4) a range of feasible alternatives (without a preferred alternative) for the preservation, interpretation, and use of resources; (5) a preliminary analysis of the economic, social, cultural, and environmental impacts of the alternatives; (6) an analysis of feasible implementation and management strategies; and (7) preliminary costs for possible National Park Service involvement if mandated by Congress. Author

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A92-10426

RECOMBINATION-DOMINATED NONEQUILIBRIUM HEAT TRANSFER TO ARBITRARILY CATALYTIC HYPERSONIC VEHICLES

G. R. INGER (Iowa State University of Science and Technology, Ames) and J. ELDER Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 5, Oct.-Dec. 1991, p. 449-455. Previously cited in issue 18, p. 2757, Accession no. A89-42086. refs
Copyright

A92-10427* Lockheed Engineering and Sciences Co., Houston, TX.

AEROASSIST FLIGHT EXPERIMENT HEATING-RATE SENSITIVITY STUDY

W. C. ROCHELLE, P. C. TING, S. A. BOUSLOG, S. R. MUELLER, J. E. COLOVIN, JR. (Lockheed Engineering and Sciences Co., Houston, TX), D. M. CURRY, and C. D. SCOTT (NASA, Johnson Space Center, Houston, TX) *Journal of Thermophysics and Heat Transfer* (ISSN 0887-8722), vol. 5, Oct.-Dec. 1991, p. 456-462. Previously cited in issue 18, p. 2763, Accession no. A89-43247. refs

Copyright

A92-10487

PREDICTION OF WAKE IN A CURVED DUCT

J. L. NARASIMHAN, V. RAMJEE, PHILIP M. DIWAKAR, and E. G. TULAPURKARA (Indian Institute of Technology, Madras, India) *International Journal for Numerical Methods in Fluids* (ISSN 0271-2091), vol. 13, Oct. 1991, p. 907-916. Research supported by Aeronautical Research and Development Board of India. refs

Experimental data on the development of an aerofoil wake in a curved stream are compared with calculations based on the k-epsilon model of turbulence with standard constants and with the model constant $C(\mu)$ dependent on the local curvature. The mean velocity profile is asymmetric, the half-width of the wake is more on the inner side of the curved duct than on the outer side, and the turbulent shear stress decreases rapidly on the outer side. The standard k-epsilon model is able to satisfactorily reproduce this behavior. Making $C(\mu)$ dependent on the local radius improves the agreement on the inner side but slightly worsens it on the outer side. Author

A92-10574

NUMERICAL SIMULATIONS OF THE STRUCTURE OF SUPERSONIC SHEAR LAYERS

B. FAROUK (Drexel University, Philadelphia, PA), E. S. ORAN, and K. KAILASANATH (U.S. Navy, Naval Research Laboratory, Washington, DC) *Physics of Fluids A* (ISSN 0899-8213), vol. 3, Nov. 1991, p. 2786-2798. Research sponsored by U.S. Navy. refs

Copyright

The mixing characteristics of unforced, planar, confined shear layers formed by two parallel streams of air have been studied through time-dependent 2D numerical calculations. The evolution of the shear layer was examined by systematically varying the velocities, densities, and the static pressures of the two streams that come into contact at the trailing edge of the plate. It was found that at least one of the streams was always supersonic. The supersonic shear layers showed some organization, albeit less coherent than their subsonic counterparts. The simulations indicate that the single convective Mach number as derived from an isentropic model is not sufficient to characterize the mixing behavior when the velocity, pressure, and density ratios are changed independently. O.G.

A92-10575

A UNIFIED NONEQUILIBRIUM MODEL FOR HYPERSONIC FLOWS

F. THIVET, M. Y. PERRIN, and S. CANDEL (Laboratoire d'Energetique Molculaire et Macroscopique-Combustion, Chatenay-Malabry, France) *Physics of Fluids A* (ISSN 0899-8213), vol. 3, Nov. 1991, p. 2799-2812. Research supported by Dassault Aviation, CNRS, and DRET. refs

Copyright

Kinetic theory is applied to a mixture of monoatomic and diatomic molecules in order to derive the macroscopic equation corresponding to the relaxation of vibrational energy. Diatomic molecules are described using the harmonic oscillator model. The SSH theory is extended and applied to evaluate the vibrational energy relaxation times which govern the process. The theoretical expressions are used to calculate the relaxation times of the main diatomic species in air: oxygen and nitrogen. These relaxation

times are in good agreement with available experimental data. A comparison with previous models is then carried out. The coupled thermodynamic and chemical relaxation occurring after a strong normal shock wave in a one-dimensional Eulerian flow is then studied. The computed results illustrate the interactions between three different phenomena: nonequilibrium thermodynamics, nonequilibrium chemistry, and dynamics of the flow. A complete analysis of these interactions is provided, and the influence of thermodynamic nonequilibrium is pointed out. Author

A92-10662

UNSTEADY INCOMPRESSIBLE VISCOUS FLOW PAST AN AIRFOIL

M. N. ZAKHARENKO (Tsentrul'nyi Aerogidrodinamicheskii Institut, Moscow, USSR) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers. A92-10654 01-34) *Archiwum Mechaniki Stosowanej* (ISSN 0373-2029), vol. 42, no. 4-5, 1990, p. 609-615. refs

Copyright

Variations in flow topology around a 12 percent Zhukovskii airfoil and in the near wake at various angles of attack are studied for viscous incompressible flow past an airfoil at $Re = 1000-10,000$. Ways of realizing boundary conditions on the solid surface for numerical solutions of 2D Navier-Stokes equations are investigated. It is shown that the realization of boundary conditions on the external boundary of the computational domain is governed strictly by the fulfillment of the airfoil pressure uniqueness condition. C.D.

A92-10663

THE JUST ATTACHED SHOCK-WAVE AT THE LEADING EDGE OF A PROFILE

J. ZIEREP and G. H. SCHNERR (Karlsruhe, Universitaet, Federal Republic of Germany) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers. A92-10654 01-34) *Archiwum Mechaniki Stosowanej* (ISSN 0373-2029), vol. 42, no. 4-5, 1990, p. 617-622. refs

Copyright

The consequences of a curvature of an attached shock at the leading edge of a slender aircraft profile being led back locally to the curvature of a profile are discussed. The local relationship between shock curvature and profile curvature at the leading edge and the influence of the shock curvature on the shock equations are addressed. C.D.

A92-10688* Cincinnati Univ., OH.

A SEMI-ELLIPTIC ANALYSIS FOR 2-D VISCOUS FLOWS THROUGH CASCADE CONFIGURATIONS

R. RAMAMURTI, U. GHIA, and K. N. GHIA (Cincinnati, University, OH) *Computers and Fluids* (ISSN 0045-7930), vol. 20, no. 3, 1991, p. 233-242. refs

(Contract NAG3-194; AF-AFOSR-85-0231; AF-AFOSR-87-0074)

Copyright

A semielliptic formulation, termed the interacting parabolized Navier-Stokes (IPNS) formulation, is developed for the analysis of a class of subsonic viscous flows for which streamwise diffusion is negligible but which are significantly influenced by upstream interactions. A two-step alternating-direction-explicit numerical scheme is developed to solve the resulting governing equations efficiently. The quasi-linearization and discretization of the equations are carefully examined so that no artificial viscosity is added externally to the scheme. Various simple channel and cascade flow configurations are examined for several values of Re , thickness ratio and Mach number, in order to establish the applicability of the IPNS model for these flows. With this model, solutions to compressible as well as nearly incompressible flows are obtained without any modification either in the analysis or in the solution procedure. Author

A92-10690

TRIPLE-DECK STRUCTURE

02 AERODYNAMICS

ALI H. NAYFEH (Virginia Polytechnic Institute and State University, Blacksburg) *Computers and Fluids* (ISSN 0045-7930), vol. 20, no. 3, 1991, p. 269-292. refs
(Contract N00014-85-K-0011; NR PROJECT 4324-201)
Copyright

The asymptotic principles of triple-deck theory are reviewed. An analysis of steady two-dimensional incompressible flow is followed by a discussion of steady two-dimensional compressible flows and, finally, by a discussion of the linear three-dimensional compressible stability of two-dimensional compressible boundary layers. For compressible flows, an equation is derived which describes perturbations of the conventional boundary layer equations due to the presence of a localized disturbance. Numerical solutions of the first- and second-order triple-deck problems are reviewed, and their accuracy and usefulness are discussed. V.L.

A92-10691 A SPATIAL MARCHING TECHNIQUE FOR THE INVISCID BLUNT BODY PROBLEM

FREDERICK G. BLOTTNER (Sandia National Laboratories, Albuquerque, NM) *Computers and Fluids* (ISSN 0045-7930), vol. 20, no. 3, 1991, p. 295-311. refs
(Contract DE-AC04-76DP-00789)
Copyright

A technique has been developed for obtaining approximate solutions of the inviscid, hypersonic flow on a blunt body with a spatial marching scheme. The scheme introduces the Vigneron pressure gradient approximation into the momentum equation in the direction along the body surface. The resulting governing equations are hyperbolic. With a specified shock wave, these equations are solved at the stagnation streamline with an iteration procedure and are solved in the downstream direction with a marching scheme. The complete Euler equations are solved with the numerical scheme when the flow is supersonic. A global iteration procedure is required to obtain the shock wave location. The approximate results from the spatial marching technique are compared with the complete solution of the Euler equations for flow over a sphere. The two results are shown to be in approximate agreement and the spatial marching technique provides useful engineering predictions while requiring considerably less computational time. Author

A92-10692* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

VISCOUS FLOW SOLUTIONS FOR SLENDER BODIES OF REVOLUTION AT INCIDENCE

VEER N. VATSA (NASA, Langley Research Center, Hampton, VA) *Computers and Fluids* (ISSN 0045-7930), vol. 20, no. 3, 1991, p. 313-320. refs
Copyright

Flow over slender prolate spheroids at incidence is examined. The incidence angle is chosen high enough to cause streamwise separation of the flow in addition to crossflow separation generally observed at lower incidence angles. The freestream Mach number for the cases investigated here is subsonic, thus precluding the use of parabolized procedures. Laminar, transitional and turbulent flow cases are investigated. Author

A92-10825 NONSTATIONARY FORCES ON A WING AIRFOIL [NESTATSIONARNYE SILY NA KRYLOVOM, OBTEKAEMOM PROFILE]

IU. L. LEVKOVSKII and IU. S. CHEKALOVA (Tsentr'alnyi Nauchno-Issledovatel'skii Institut imeni A.N. Krylova, Leningrad, USSR) *Akusticheskii Zhurnal* (ISSN 0320-7919), vol. 37, May-June 1991, p. 505-511. In Russian. refs
Copyright

The paper is concerned with the problem of determining the nonstationary drag force acting on an airfoil of finite thickness in nonstationary flow. This force can be determined by solving a problem similar to the well known Sears problem concerning a nonstationary lifting force on a flat plate. In the present case,

however, the tangential velocity component is important. Changes in the nonstationary drag force are analyzed as a function of the geometrical parameters of the wing. V.L.

A92-10901 AN EXPERIMENTAL STUDY OF SUBSONIC SEPARATED FLOW OVER PARAWINGS [EKSPERIMENTAL'NYE ISSLEDOVANIYA DOZVUKOVOGO SRYVNOGO OBTEKANIIA DEL'TOPLANOV]

V. I. VORONIN and A. I. SHVETS (Moskovskii Universitet, Vestnik, Seriya 1 - Matematika, Mekhanika (ISSN 0579-9368), May-June 1991, p. 84-86. In Russian. refs
Copyright

Results of experimental studies of the aerodynamic characteristics of parawing models are reported, covering a wide range of angles of attack under conditions of separated flow. It is shown, in particular, that as the free-stream Mach number increases from 0.4 to 0.8, the lifting force and pressure center coefficients increase by 5 percent, with a slight decrease in the lift-drag ratio. The model characteristics and details of the experimental procedure are described. V.L.

A92-10907 TWO-PHASE FLOWS AT SUPERSONIC VELOCITIES [DVUKHFAZNYYE TECHENIYA PRI SVERKHZVUKOVYKH SKOROSTIYAKH]

O. A. POVAROV and V. A. FILIPPENKO (Moskovskii Energeticheskii Institut, Moscow, USSR) *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), vol. 29, July-Aug. 1991, p. 738-744. In Russian. refs
Copyright

The paper deals with the interaction between a shock wave and a two-phase vapor flow. Measurements of changes in the disperse composition of wet steam behind the shock wave are presented for different flow velocities. An analysis is made of a reduction in the erosion wear of specimens in supersonic flow of wet steam resulting from the fractionation of liquid particles in the shock wave. V.L.

A92-10958 AERODYNAMIC MODIFICATION OF A PROPELLER

MING ZENG and GAOCHI GU (Beijing University of Aeronautics and Astronautics, People's Republic of China) *Journal of Aerospace Power* (ISSN 1000-8055), vol. 6, Oct. 1991, p. 305-309. In Chinese. refs

The aerodynamic design features of a propeller have been analyzed. On the basis of analytical results and modern advancements in propeller technology, the specifications of its expected modification have been proposed. In its overall design the important parameters have been determined. The principles of optimization and the version selection are outlined. From the comparison between the wind tunnel testing results of both scaled models of the propeller and its modification, it is concluded that the modification is a great success. Its static thrust and takeoff climb efficiency are increased by 13.8 and 8.76 percent, respectively. Its cruise efficiency and noise level are also slightly improved. Author

A92-10959 SURFACE FLOW VISUALIZATION OF ROTATING PROPELLER

XICHANG MAO, MING ZENG, and CHUNFENG GAO (Beijing University of Aeronautics and Astronautics, People's Republic of China) *Journal of Aerospace Power* (ISSN 1000-8055), vol. 6, Oct. 1991, p. 310-312. In Chinese. refs

Surface flow visualization has been carried out with tufts adhered to the surfaces of rotating propeller blades. From the experimental results, it is found that on four-fifths of the blade surface from hub to tip, the air flow runs from the leading edge to the trailing edge in an outward direction with some inclination to chord. On the remaining one-fifth near the blade tip, flow separation and reverse flow occur at the blade surface, and negative thrust emerges, which reduces the efficiency of the propeller. Author

A92-10975

APPLICATION OF COMPOUND LEANED BLADES TO CONTROLLING SECONDARY FLOW

JIEXIAN SU, GUOTAI FENG, and ZHONGQI WANG (Harbin Institute of Technology, People's Republic of China) *Journal of Aerospace Power* (ISSN 1000-8055), vol. 6, Oct. 1991, p. 371, 372. In Chinese. refs

The mechanism of controlling secondary flow by using positive leaned blades or compound leaned blades is considered. It is concluded that the positive leaned blades produce a converse radial pressure gradient at the hub. Under its action the low-energy fluid in the blade surface boundary layer is shifted from hub to midspan, the blade-to-blade transverse pressure gradient is reduced, passage vortices are weakened, and hence the secondary flow losses are decreased. A computation of the compound leaned blades applied to guide vanes in a small engine has been performed as an example. Its results show that by comparison with conventional blades, the degree of reaction and static pressure at the hub of the compound leaned blades are increased, and the flow behavior near the hub of working blades is improved. The degree of reaction at the tip is reduced and therefore the leakage losses are cut down, too. It is proved that the positive leaned or the compound leaned blades are applicable to controlling the spanwise pressure gradient, the stage reaction, and the downstream effect of the secondary flow. Author

A92-11013*# New Mexico State Univ., Las Cruces.

DETERMINATION OF BALLOON DRAG

GEORGE R. CONRAD (New Mexico State University, Las Cruces) and EDWARD J. ROBBINS (NASA, Wallops Flight Center, Wallops Island, VA; New Mexico State University, Las Cruces) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 72-82. refs (AIAA PAPER 91-3666)

The evolution of an empirical drag relationship that has stimulated rethinking regarding the physics of balloon drag phenomena is discussed. Combined parasitic drag from all sources in the balloon system are estimated to constitute less than 10 percent of the total system drag. It is shown that the difference between flight-determined drag coefficients and those based on the spherical assumption should be related to the square of the Froude number. R.E.P.

A92-11051

EFFECT OF RIBLETS ON TURBULENCE IN THE WAKE OF AN AIRFOIL

J. M. CARAM and A. AHMED (Texas A & M University, College Station) *AIAA Journal* (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1769, 1770. Abridged. Previously cited in issue 21, p. 3251, Accession no. A89-47658. refs Copyright

A92-11057* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

IMPLICIT FLUX-SPLIT EULER SCHEMES FOR UNSTEADY AERODYNAMIC ANALYSIS INVOLVING UNSTRUCTURED DYNAMIC MESHES

JOHN T. BATINA (NASA, Langley Research Center, Hampton, VA) *AIAA Journal* (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1836-1843. Previously cited in issue 11, p. 1605, Accession no. A90-29362. refs Copyright

A92-11058* Virginia Polytechnic Inst. and State Univ., Blacksburg.

THREE-DIMENSIONAL SPACE-MARCHING ALGORITHM ON UNSTRUCTURED GRIDS

W. D. MCGRORY (AeroSoft, Inc., Blacksburg, VA), R. W. WALTERS (Virginia Polytechnic Institute and State University, Blacksburg), and R. LOHNER (George Washington University, Washington, DC) *AIAA Journal* (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1844-1849. Previously cited in issue 08, p. 1108, Accession no.

A90-23701. refs

(Contract NSF ISI-88-61052; NAG1-776)

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A92-11059

SIMPLE TURBULENCE MODELS FOR SUPERSONIC FLOWS - BODIES AT INCIDENCE AND COMPRESSION CORNERS

SIAMACK A. SHIRAZI and C. R. TRUMAN (New Mexico, University, Albuquerque) *AIAA Journal* (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1850-1859. Research supported by Sandia National Laboratories. Previously cited in issue 09, p. 1285, Accession no. A89-25530. refs

Copyright

A92-11061

CORRELATION OF SEPARATION SHOCK MOTION WITH PRESSURE FLUCTUATIONS IN THE INCOMING BOUNDARY LAYER

M. E. ERENGIL and D. S. DOLLING (Texas, University, Austin) *AIAA Journal* (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1868-1877. Previously cited in issue 16, p. 2485, Accession no. A90-38774. refs

(Contract AF-AFOSR-86-0112)

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A92-11062

NUMERICAL INVESTIGATION OF BLEED ON THREE-DIMENSIONAL TURBULENT INTERACTIONS DUE TO SHARP FINS

DOYLE KNIGHT (Rutgers University, Piscataway, NJ) and DATTA GAITONDE *AIAA Journal* (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1878-1885. refs

(Contract AF-AFOSR-86-0266)

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A numerical investigation is focused on the effect of bleed on the three-dimensional turbulent interaction generated by a sharp fin at Mach 3. For an incipiently separated configuration (8 deg fin, $Re_{sub} \delta = 5.6 \times 10^5$), 23-percent suction is applied over a rectangular area beneath the inviscid shock. Comparison with experimental data and analysis of computed results indicate that the effect of bleed is primarily to reduce surface angularity and upstream influence. The major portion of the flow is not influenced by suction. For a strong interaction (20-deg fin, $Re_{sub} \delta = 8.8 \times 10^5$), the effect of bleeding up to 25 percent of the boundary layer from two distinct regions on the plate jointly covering the region between the line of upstream influence and the base of the fin is studied. Numerical results are compared with available experimental data in the form of surface pressures and boundary-layer surveys of pitot pressure and yaw angle in the absence of bleed. Author

A92-11063

FINITE ELEMENT SOLUTIONS OF THE EULER EQUATIONS FOR TRANSONIC EXTERNAL FLOWS

G. S. BARUZZI, W. G. HABASHI (Concordia University, Montreal, Canada), and M. M. HAFEZ (California, University, Davis) *AIAA Journal* (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1886-1893. Research supported by NSERC. Previously cited in issue 10, p. 1434, Accession no. A90-26945. refs

Copyright

A92-11066

COMPUTATION OF STEADY AND UNSTEADY CONTROL SURFACE LOADS IN TRANSONIC FLOW

BALA K. BHARADVAJ (Douglas Aircraft Co., Long Beach, CA) *AIAA Journal* (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1906-1911. Research supported by McDonnell Douglas Corp. Previously cited in issue 11, p. 1604, Accession no. A90-29361. refs

Copyright

A92-11067

FLOW ANALYSIS AND DESIGN OF THREE-DIMENSIONAL WIND TUNNEL CONTRACTIONS

YAO-XI SU (Northwestern Polytechnical University, Xian, People's

Republic of China) AIAA Journal (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1912-1920. refs
Copyright

Remarkable progress has been made in the investigation of wind tunnel contractions since the introduction of numerical analysis. However, until recently, most of the work is concerned with two-dimensional or axisymmetric contractions. In the present paper a numerical analysis of incompressible potential flow in wind tunnel contractions with rectangular cross section is conducted. Criteria for the design and performance comparisons of such contractions are discussed, with emphasis on the representation of three-dimensional effects. Five criteria are suggested, including pressure extrema, flow nonuniformity, and crossflow features, which are thought to be useful in the design of rectangular contractions. Contours of a single-parameter family are employed to facilitate the study. Seven geometric parameters are required to define a rectangular contraction. The main subject of this work is a comparative parametric study in which a systematic investigation of the relation between the geometric parameters and the design criteria of three-dimensional contractions is attempted. Author

A92-11080 KERNEL FUNCTION OCCURRING IN SUPERSONIC UNSTEADY POTENTIAL FLOW

MAHER N. BISMARCK-NASR (Instituto Tecnológico de Aeronautica, Sao Jose dos Campos, Brazil) AIAA Journal (ISSN 0001-1452), vol. 29, Nov. 1991, p. 2006, 2007. refs
Copyright

Consideration is given to simple and direct expressions for the evaluation of the nonelementary part of the kernel function of the integral equation relating the pressure and the normal wash distribution in supersonic unsteady flow. It is shown that the solutions presented are related to the same functional solutions of the subsonic kernel. It is concluded that the expressions can provide the basis for the development of numerical nonstationary interfering lifting surface methods. O.G.

A92-11286 DESIGN AND TESTING OF A CONTROLLED DIFFUSION AIRFOIL CASCADE FOR INDUSTRIAL AXIAL FLOW COMPRESSOR APPLICATION

W. STEINERT, H. STARKEN (DLR, Institut fuer Antriebstechnik, Cologne, Federal Republic of Germany), and B. EISENBERG (MAN Gutehoffnungshuette AG, Oberhausen, Federal Republic of Germany) ASME, Transactions, Journal of Turbomachinery (ISSN 0889-504X), vol. 113, Oct. 1991, p. 583-590. refs
(ASME PAPER 90-GT-140) Copyright

Similar to jet engine development, modern design methods are used today to improve the performance of industrial compressors. In order to verify the loading limits, a cascade profile representative for the first rotor hub section of an industrial compressor has been designed by optimizing the suction surface velocity distribution using a direct boundary layer calculation method. The blade shape was computed with an inverse full potential code and the resulting cascade was tested in a cascade wind tunnel. The experimental results confirmed the design intent and resulted in a low loss coefficient of 1.8 percent at design condition and an incidence range of nearly 12 deg (4 percent loss level) at an inlet Mach number of 0.62. Author

A92-11287 INVESTIGATION OF THE FLOW AT THE EXIT OF AN UNSHROUDED CENTRIFUGAL IMPELLER AND COMPARISON WITH THE 'CLASSICAL' JET-WAKE THEORY

K.-H. ROHNE and M. BANZHAF (ABB Turbo Systems, Ltd., Baden, Switzerland) ASME, Transactions, Journal of Turbomachinery (ISSN 0889-504X), vol. 113, Oct. 1991, p. 654-659. refs
(ASME PAPER 90-GT-124) Copyright

L2F measurements of the flow at the exit of modern unshrouded centrifugal impellers with backswept blades yield a much more uniform velocity profile compared to former measurements on impellers with radial blading. Further evaluations show that the 'classical' jet-wake theory assuming an isentropic jet and a wake

flow congruent with the shape of the blade at the impeller exit needs correction in order to obtain meaningful results when interpreting thermodynamic measurements on centrifugal compressor stages. Author

A92-11328 CONTROL THEORY FOR OPTIMUM DESIGN OF AERODYNAMIC SHAPES

ANTONY JAMESON (Princeton University, NJ) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 176-179. refs
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The potential benefits and feasibility of combining control and aerodynamic theory to develop a method for designing optimum aerodynamic shapes are examined. In this approach the design problem is regarded as a control problem in which the controlled system is the aerodynamic flow, and the control is the shape of the boundary. A variety of alternative formulations of the design problem can then be treated systematically by using the mathematical theory of control for systems governed by partial differential equations. Since the design is frozen before the construction of the aircraft, only an open-loop solution to the control problem should be found. I.E.

A92-11605*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

COMPUTATIONAL INVESTIGATION OF CIRCULAR-TO-RECTANGULAR TRANSITION DUCTS

S. P. PAO, JOHN R. CARLSON (NASA, Langley Research Center, Hampton, VA), and KHALED S. ABDOL-HAMID (Analytical Services and Materials, Inc., Hampton, VA) AIAA, Applied Aerodynamics Conference, 9th, Baltimore, MD, Sept. 23-25, 1991. 15 p. refs
(AIAA PAPER 91-3342) Copyright

A study demonstrating that flows inside transition ducts with unusual geometry can be analyzed by employing proper selections of a Navier-Stokes code, grid topology, and turbulence modeling is presented. Based on comparison between existing experimental data and the computed results for the same configurations, reasonable agreements were obtained for wall static pressure in the transition duct. Static pressure comparisons in the supersonic nozzle section were excellent, as well as agreement between computed and measured mass flow and thrust performance. R.E.P.

A92-12134 SUBSONIC AXISYMMETRIC VISCOELASTIC FLOW PAST THIN TAPERED BODIES OF REVOLUTION [DOZVUKOV OSESIMMETRICHNOE OBTEKANIE TONKIKH ZAOSTRENNYKH TEL VRASHCHENIIA UPRUGOPLASTICHESKIM POTOKOM]

L. M. FLITMAN Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela (ISSN 0572-3299), July-Aug. 1991, p. 155-164. In Russian. refs
Copyright

Steady-state subsonic flow of a viscoelastic medium past semiinfinite thin bodies of revolution is investigated analytically with allowance for friction. Procedures for determining the field in the plastic and elastic regions are described. The discussion also covers the determination of the unknown functions, solution analysis, and consideration of the effect of flow velocity on the drag force. V.L.

A92-12164 PRESSURE ON A CYLINDER WITH A SCREEN IN TRANSVERSE FLOW [DAVLENIE NA POPERECHNO OBTEKAEMOM TSILINDRE S EKRANOM]

N. M. BYCHKOV, N. D. DIKOVSKAIA, and V. V. LARICHKIN (AN SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0002-3434), Jan.-Feb. 1991, p. 72-79. In Russian. refs
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Transverse flow past a cylinder near a plane surface was

investigated experimentally in a subsonic wind tunnel for relatively small distances between the cylinder and the plane surface (h equals less than 0.1 of the cylinder diameter) and Reynolds numbers up to 6×10^5 . The presence of a positive pressure gradient in front of the cylinder contributes to the formation of a turbulent boundary layer on the plane surface. For h less than 0.06, perturbations from the screen give rise to turbulence on the upper cylinder wall, shifting the separation point further downstream and producing an abrupt increase in the lift force. Flow laminarization for h greater than 0.06 shifts the separation point upstream, leading to a partial channel locking and an anomalous increase in the lift force. V.L.

A92-12165

BASE PRESSURE ON AN AXISYMMETRIC FINNED BODY DURING FORCED ROTATION IN THE AUTOROTATION REGIME [DONNOE DAVLENIE NA OPERENNOM OSESIMMETRICHNOM TELE PRI PRINUDITEL'NOM VRASHCHENII I NA REZHIME AVTOROTATSII]

V. M. KOVALENKO, L. G. ROZHKOVA, and D. L. KHOKHLOV (Khar'kovskii Politekhnikeskii Institut, Sumy, Ukrainian SSR) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0002-3434), Jan.-Feb. 1991, p. 80-85. In Russian. refs
Copyright

Base pressure measurements are presented for a rotating axisymmetric body with and without a tail assembly over a wide range of the rotation parameter Θ (between -0.28 and 3.67). The results are quantitatively consistent with the findings of an earlier study (Kovalenko and Voronov, 1987) concerning the effect of a swirling flow on the rarefaction in the base region and formation of a pressure gradient over the base radius. It is suggested that the magnitude and the rate of change of the base pressure of a rotating axisymmetric body can be controlled by means of tail fins. V.L.

A92-12169

EVOLUTION OF THREE-DIMENSIONAL FLOWS DURING THE INTERACTION BETWEEN CONICAL SHOCK WAVES AND A TURBULENT BOUNDARY LAYER [RAZVITIE PROSTRANSTVENNYKH TECHENII PRI VZAIMODEISTVII KONICHESKIKH SKACHKOV UPLOTNENIIA S TURBULENTNYM POGRANICHNYM SLOEM]

A. A. ZHELTOVODOV and A. I. MAKSIMOV (AN SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0002-3434), Mar.-Apr. 1991, p. 88-98. In Russian. refs
Copyright

Supersonic flow past half-cones located on a plate was investigated experimentally in a systematic manner in order to gain a better understanding of the evolution of three-dimensional turbulent flows and to compare some of the flow characteristics for different geometrical configurations. The experiments were carried out in a wind tunnel for an adiabatic model surface at free-stream Mach 2.27, 3, and 4. It is found, in particular, that, for moderate intensities of sliding shock waves, flow in the mixing region is characterized by predominantly horizontal deviations of the flow lines. A significant restructuring of the flow observed for high shock wave intensities suggests the formation of a three-dimensional separation. V.L.

A92-12170

COMPARATIVE STUDIES OF FLOW AROUND A WING PROFILE IN TWO WIND TUNNELS [SRVNIENIE ISSLEDOVANIYA OBEKANIYA PROFILIA KRYLA V DVUKH AERODINAMICHESKIKH TRUBAKH]

B. I. ZANIN and V. N. LUSHIN (AN SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0002-3434), Mar.-Apr. 1991, p. 99-103. In Russian. refs
Copyright

The laminar-turbulent transition in the boundary layer on a wing profile was investigated experimentally in two wind tunnels, a commercial wind tunnel and a smaller low-turbulence wind tunnel,

T-324. In both wind tunnels, the experiments focused on the measurements of the length of the laminar flow section on the wing surface and on the physical mechanism of the laminar-turbulent transition. Data on the laminar-turbulent transition obtained in the two wind tunnels for moderate and low turbulence are found to be similar. V.L.

A92-12173

COMPARATIVE ANALYSIS OF THE LIFT-DRAG RATIO AND HEAT FLOWS TOWARD THE SURFACE OF WAVE RIDERS OF DIFFERENT CONFIGURATIONS [SRVNIENIE ANALIZ AERODINAMICHESKOGO KACHESTVA I TEPOVYKH POTOKOV K POVERKHNOSTI VOLNOLETOV RAZLICHNOI FORMY]

I. I. MAZHUL' and I. I. IAKOVLEV (AN SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0002-3434), May-June 1991, p. 73-76. In Russian. refs
Copyright

A comparative analysis of the aerodynamic characteristics of different types of simple wave riders is made with allowance for constraints on the body surface temperature. Although the requirements for minimizing heat fluxes and maximizing the lift-drag ratio are shown to be contradictory, it is found that, over certain ranges of parameters, configurations can be determined which provide for lower heat fluxes toward the body surface and higher values of the lift-drag ratio. V.L.

A92-12178

AN EFFICIENT METHOD FOR CALCULATING THREE-DIMENSIONAL TRANSONIC FLOW PAST AIR INTAKES [EFFEKTIVNYI METOD RASCHETA PROSTRANSTVENNOGO OBEKANIYA VOZDUKHOZABORNIKOV NA OKOLOZVUKOVYKH SKOROSTIAXH]

D. A. LIUBIMOV Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 31, Sept. 1991, p. 1355-1368. In Russian. refs
Copyright

The objective of the study was to develop an efficient method and an algorithm for calculating three-dimensional transonic flows past air intakes, paying particular attention to the reliability of the method when used with inhomogeneous grids. The full equation for the potential, written in conservative form in arbitrary nonorthogonal coordinates, is solved using the approximate factorization method. The approximate factorization operator used here provides a factor of 2-2.5 faster convergence than other existing operators. V.L.

A92-12179

CALCULATION OF FLOW OF A RADIATING GAS IN AXISYMMETRIC NOZZLES OF SPECIFIED SHAPE [RASCHET TECHENII IZLUCHAIUSHCHEGO GAZA V OSESIMMETRICHNYKH SOPLAKH ZADANNOI FORMY]

A. A. FROLOVA Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 31, Sept. 1991, p. 1381-1391. In Russian. refs
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The effect of spectral radiation transfer on gas flow in nozzles of a given configuration is investigated analytically. The gas temperature at the nozzle inlet is assumed to be known. The dependence of the gas pressure at the nozzle wall is determined as a function of radiation transfer. An analysis is also made of the effect of radiation on the integral characteristics of gas flow. V.L.

A92-12203

MODELING OF THE VORTEX STRUCTURE AT DELTA WINGS OF LOW ASPECT RATIO BY THE DISCRETE VORTEX METHOD [MODELIROVANIE VIKHREVOI STRUKTURY U TREUGOL'NYKH KRYL'EV MALOGO UDLINENIIA METODOM DISKRETNYYKH VIKHREI]

N. F. VOROB'EV and G. N. SHASHKINA (AN SSSR, Institut

Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0869-1339), July-Aug. 1991, p. 32-35. In Russian. refs

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A scheme is proposed which models the formation of a vortex core over a delta wing of low aspect ratio. The approach used is based on the discrete vortex scheme of a thin wing of finite span which allows for the dependence of the intensity of the shed vortex sheet on the leading edge sweep angle. Results of calculations are presented, and it is shown that the scheme remains stable at large angles of attack. V.L.

A92-12204

EXPERIMENTAL AND THEORETICAL STUDY OF THE IMPROVEMENT OF THE AERODYNAMIC CHARACTERISTICS OF SUPERSONIC FLOW PAST BODIES WITH SURFACE INJECTION OF A GAS JET WITH PARTICLES

[EKSPERIMENTAL'NOE I TEORETICHESKOE ISSLEDOVANIE ULUCHSHENIIA AERODINAMICHESKIKH KHARAKTERISTIK SVERKHZVUKOVOGO OBTEKANIIA TEL PRI VYDUVE IZ NIKH STRUI GAZA S CHASTITSAMI]

N. P. GRIDNEV, S. S. KATSNEL'SON, V. M. FOMIN, and V. P. FOMICHEV (AN SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0869-1339), July-Aug. 1991, p. 36-39. In Russian. refs

Copyright

Supersonic flow past bodies of revolution is investigated theoretically and experimentally in the case of the local injection of a gas jet with particles from the body surface. The internal structure of such flows is characterized, and it is shown that surface injection of a gas jet with particles makes it possible to decrease the aerodynamic drag to a greater extent than with traditional method, including the injection of a single-phase jet. In the case of bodies moving at high supersonic velocities, the injection of a two-phase jet may also provide an effective method of reducing heat transfer toward the body walls. V.L.

A92-12399

AXISYMMETRIC POTENTIAL FLOW CALCULATIONS. II - DESIGN MODE

S. ZHANG, R. M. BARRON (Windsor, University, Canada), and N. RUDRAIAH (Bangalore University, India) Communications in Applied Numerical Methods (ISSN 0748-8025), vol. 7, Oct. 1991, p. 563-567. Research supported by NSERC. refs

Copyright

The pure inverse problem of designing a body with a prescribed surface pressure in incompressible axisymmetric potential flow is solved using the streamfunction as a co-ordinate in the computational plane. The problem is formulated mathematically as a mixed boundary value problem and the solution is obtained using the finite-difference technique. The body shape is computed simultaneously with the entire flowfield and does not have to be iteratively adjusted to meet the target surface pressure. Results are presented for elliptical, NACA 0012 and minimum-drag cross-sections. Author

A92-12423

A NUMERICAL SIMULATION OF SEPARATED FLOWS AROUND BODIES

SHIGERU ASO and ATSUHIRO SAKAMOTO Kyushu University, Technology Reports (ISSN 0023-2718), vol. 64, Aug. 1991, p. 249-255. In Japanese. refs

Dynamic stall phenomena have been investigated numerically by solving incompressible Navier-Stokes equations by a third-order upwind scheme in order to reveal the flow structure and mechanism of dynamic stall. At first, in order to examine the validity of the calculations separated flows around circular cylinder are calculated. The results show excellent agreements with the experiments. Also, separated flows around a wing section at fixed attack angle are calculated and the results show excellent agreements with experiments which are conducted by the present authors. Finally, separated flows around oscillating airfoil in pitch are calculated by

using moving mesh system. The flow conditions are selected from the experiments. The calculated separated region is small in pitching-up process and it becomes large in a pitching-down process. Quite different characteristics of flow patterns between a pitching-up and pitching-down processes are obtained. Author

A92-12424

A STUDY ON THE INTERACTION BETWEEN A BOW SHOCK WAVE GENERATED BY A BLUNT BODY AND A TURBULENT BOUNDARY LAYER

SHIGERU ASO, SHIGEHIDE NAKAO, SYOUZOU MAEKAWA, KAZUO ARASHI, KENJI TOMIOKA, and HIROYUKI YAMAO Kyushu University, Technology Reports (ISSN 0023-2718), vol. 64, Aug. 1991, p. 257-263. In Japanese. refs

An interaction between a bow shock wave generated by a blunt body and a turbulent boundary layer have been investigated experimentally in order to reveal the complicated flowfields of 3D shock wave/turbulent boundary layer interaction. Experiments have been conducted under the conditions of freestream Mach number of 3.83, total pressure of 1.2×10^6 Pa and Reynolds number of 2.8×10^7 with almost adiabatic wall conditions. In the experiments, a blunt body model is set above a flat plate model and a bow shock wave generated by the blunt body model impinges on a turbulent boundary layer on the flat plate. The various values of the gap between the blunt body and the flat plate are tested in the experiments, and the effects of the gap on the interacting flowfields are studied. The results show that the effects of the gap are quite remarkable and the interaction region reduces as the gap is increased. Author

A92-12649

NUMERICAL SOLUTION OF STEADY INCOMPRESSIBLE VISCOUS FLOWS OVER AIRFOILS

KAREL KOZEL (Czech Technical University, Prague, Czechoslovakia) and TOMAS HULEK Acta Technica CSAV (ISSN 0001-7043), vol. 36, no. 5, 1991, p. 521-533. refs

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A method of solving 2D steady laminar incompressible viscous flows over airfoils has been developed. The results of tests of the method on NACA 0012 airfoils show good correspondence with expected behavior, and a remarkable dependence of the results on mesh resolution is seen at high Re values close to the limit of the existence of a steady solution. Several relative advantages of the artificial compressibility concept and the time-marching methods are discussed. C.D.

A92-12741*#

Virginia Polytechnic Inst. and State Univ., Blacksburg.

THE DYNAMIC CHARACTER OF THE WAKE OF AN AXISYMMETRIC BODY AT AN ANGLE OF ATTACK

N. T. HOANG and D. P. TELIONIS (Virginia Polytechnic Institute and State University, Blacksburg) AIAA, Applied Aerodynamics Conference, 9th, Baltimore, MD, Sept. 23-25, 1991. 13 p. refs (Contract NAS1-18471)

(AIAA PAPER 91-3268) Copyright

The flow around a hemisphere-cylinder was studied at angles of attack $\alpha = 0-90$ deg. The work was carried out in two wind tunnels, using hot wire anemometers and seven-hole probes at Reynolds number of 2.7×10^4 . Five distinct states of vortex unsteadiness were detected. For angles of attack less than 14 deg, the flow is rather stable. For α between 15 and 23 deg, meandering occurs at a reduced frequency of 0.065. For α between 24 and 32 deg, three frequencies were recorded at 0.11, 0.21, and 0.31. At even higher angles of attack, α between 33 and 41 deg, two frequencies were seen at 0.11 and 0.19. The onset of alternate shedding is at $\alpha = 42$ deg, above which, alternate shedding occurred at 0.065. However, above 55 deg, shedding occurred at 0.15. Asymmetric wake structures over the hemisphere-cylinder were also investigated. It was found that asymmetric structures too are not steady but engage in periodic organized motions. Author

A92-12808

VIBRATION OF A WING OF FINITE SPAN IN SUBSONIC FLOW AT SMALL DISTANCES FROM A SOLID BOUNDARY
[KOLEBANIIA KRYLA KONECHNOGO RAZMAKHA V DOZVUKOVOM POTOKE NA MALYKH OTSTOIANIIAKH OT TVERDOI GRANITSY]

I. I. EFREMOV and E. P. LUKASHCHIK (Kievskii Politekhnikheskii Institut, Kiev, Ukrainian SSR) *Gidromekhanika* (ISSN 0367-4088), no. 63, 1991, p. 55-60. In Russian. refs

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The asymptotic approximation of small distances from a solid boundary is used to obtain an analytical expression relating the lift coefficient to the wing vibration frequency at subsonic flight velocities. The problem is solved by using acceleration potential and solution separation methods. Calculation of lift force components are presented for wings of aspect ratios of 2 and 6 for Mach 0.3 and 0.5. V.L.

A92-13198

SOLUTION OF THE REYNOLDS-AVERAGED NAVIER-STOKES EQUATIONS FOR TRANSONIC AEROFOIL FLOWS

L. J. JOHNSTON (University of Manchester Institute of Science and Technology, England) *Aeronautical Journal* (ISSN 0001-9240), vol. 95, Oct. 1991, p. 253-273. refs

Copyright

A computational method to predict the viscous transonic flow developed around two-dimensional aerofoil sections is described. The Reynolds-averaged Navier-Stokes equations applicable to turbulent flow are discretized in space using a cell-centered finite-volume formulation. A multi-stage, explicit, time-marching scheme is used to advance the unsteady flow equations in time to a steady-state solution. Turbulence closure is achieved using either the Baldwin-Lomax algebraic model, or a one-equation model based on the turbulent kinetic energy equation. This latter equation is solved using essentially identical procedures to those for the mean-flow equations. Results are presented for the RAE 2822, RAE 5225, CAST 7 and MBB-A3 transonic aerofoil sections. The relative performance and limitations of the two turbulence models are discussed. Author

A92-13200

JET INFLOW SIMULATION AND ITS DOWNWASH EFFECT ON LIFTING SURFACES

P. A. O. SOVIERO and J. B. V. WANDERLEY (Instituto Tecnológico de Aeronautica, Sao Jose dos Campos, Brazil) *Aeronautical Journal* (ISSN 0001-9240), vol. 95, Oct. 1991, p. 283-288. refs

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A turbulent hot jet is calculated and its entrainment effect is modeled by a line sink with the objective of estimating the downwash effect on rectangular lifting surfaces of various aspect ratios. The line sink density is determined by numerical solution of the free shear layer equations with a turbulent kinetic energy model. The 'incompressible equivalent jet' concept is verified within the context of practical engineering calculations. Author

A92-13202* Lockheed Engineering and Sciences Co., Hampton, VA.

EULER CODE EVALUATION OF A TRANSATMOSPHERIC VEHICLE AT SUPERSONIC SPEEDS

BRIAN E. MCGRATH, IRA J. WALKER (Lockheed Engineering and Sciences Co., Hampton, VA), PETER F. COVELL, and STEVEN X. S. BAUER (NASA, Langley Research Center, Hampton, VA) *Journal of Aircraft* (ISSN 0021-8669), vol. 28, Nov. 1991, p. 683-688. Previously cited in issue 21, p. 3261, Accession no. A89-49681. refs

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A92-13203* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

COMPUTATION OF THREE-DIMENSIONAL TURBULENT VORTICAL FLOWS ON BODIES AT HIGH INCIDENCE

LEWIS B. SCHIFF, DAVID DEGANI, and RUSSELL M. CUMMINGS (NASA, Ames Research Center, Moffett Field, CA) (Symposium

on Numerical and Physical Aspects of Aerodynamic Flows, 4th, Long Beach, CA, Jan. 16-19, 1989, Proceedings) *Journal of Aircraft* (ISSN 0021-8669), vol. 28, Nov. 1991, p. 689-699. Previously cited in issue 05, p. 608, Accession no. A90-16772. refs

A92-13205* McDonnell-Douglas Corp., Saint Louis, MO.

BOUNDARY-LAYER AND WAKE MEASUREMENTS ON A SWEEPED, CIRCULATION-CONTROL WING

FRANK W. SPAID (McDonnell Douglas Corp., Saint Louis, MO) and EARL R. KEENER (NASA, Ames Research Center, Moffett Field, CA) *Journal of Aircraft* (ISSN 0021-8669), vol. 28, Nov. 1991, p. 706-712. Previously cited in issue 08, p. 1034, Accession no. A87-22449. refs

Copyright

A92-13206 California Univ., Davis.

EXPERIMENTAL INVESTIGATION ON THE EFFECT OF CRESCENT PLANFORM ON LIFT AND DRAG

C. P. VAN DAM (California, University, Davis), P. M. H. W. VIJGEN (High Technology Corp., Hampton, VA), and B. J. HOLMES (NASA, Langley Research Center, Hampton, VA) *Journal of Aircraft* (ISSN 0021-8669), vol. 28, Nov. 1991, p. 713-720. Previously cited in issue 08, p. 1102, Accession no. A90-22196. refs

(Contract NAG1-732; NCA2-397; NAS1-18240)

A92-13207* McDonnell Aircraft Co., Saint Louis, MO.

SUPERSONIC BOUNDARY-LAYER STABILITY ANALYSIS ON AN AIRCRAFT WING

SHREEKANT AGRAWAL, THOMAS A. KINARD (McDonnell Aircraft Co., Saint Louis, MO), and ARTHUR G. POWELL (Douglas Aircraft Co., Long Beach, CA) (Symposium on Numerical and Physical Aspects of Aerodynamic Flows, 4th, Long Beach, CA, Jan. 16-19, 1989, Proceedings) *Journal of Aircraft* (ISSN 0021-8669), vol. 28, Nov. 1991, p. 721-727. Previously cited in issue 05, p. 609, Accession no. A90-16792. refs

(Contract NAS1-18037)

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A92-13209

LIFT DEVELOPMENT OF DELTA WINGS UNDERGOING CONSTANT ACCELERATION FROM REST

R. S. SAWYER (Boeing Commercial Airplane Group, Seattle, WA) and JOHN P. SULLIVAN (Purdue University, West Lafayette, IN) *Journal of Aircraft* (ISSN 0021-8669), vol. 28, Nov. 1991, p. 735-740. Previously cited in issue 06, p. 756, Accession no. A90-19789. refs

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A92-13210* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PROBE SHAPES FOR STREAMWISE MOMENTUM AND CROSS-STREAM TURBULENCE INTENSITY

VERNON ROSSOW, J. (NASA, Ames Research Center, Moffett Field, CA) *Journal of Aircraft* (ISSN 0021-8669), vol. 28, Nov. 1991, p. 741-749. refs

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When the highly turbulent flowfields at the edges of jets, in augmentors, and in other jet-mixing devices are surveyed with conventional pitot probes, the values indicated by the instruments may contain a significant increment brought about by the dynamics of the eddies. Although the influence of turbulence on the measurements is usually negligible in streams where the turbulence level is 1 percent or less, the effect of turbulence on static and total pressure measurements can be around 20 percent when the turbulence level exceeds 40 percent. This paper describes a theoretical study that develops probe shapes that directly measure the time-averaged total pressure based on the streamwise component of the velocity vector to obtain a direct measurement of the streamwise momentum. The difference between the time-averaged pressure indicated by such a probe and one that measures the total head based on the entire velocity vector yields the cross-stream turbulence intensity. Author

A92-13211* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PROBE SYSTEMS FOR STATIC PRESSURE AND CROSS-STREAM TURBULENCE INTENSITY

VERNON ROSSOW, J. (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 750-755. refs
Copyright

A recent study of total-pressure probes for use in highly turbulent streams is extended herein by developing probe systems that measure time-averaged static or ambient pressure and turbulence intensity. Arrangements of tubular probes of circular and elliptical cross section are described that measure the pressure at orifices on the sides of the probes to obtain different responses to the cross-stream velocity fluctuations. When the measured data are combined to remove the effect of the presence of the probes on the local pressure, the time-averaged static pressure and the cross-stream components of turbulence intensity can be determined. If a system of total pressure tubes, as described in an accompanying paper, is added to the static pressure group to form a single cluster, redundant measurements are obtained that permit accuracy and consistency checks. Author

A92-13212* Maryland Univ., College Park.

ANALYSIS OF UNSTEADY PRESSURES INDUCED ON A BODY BY A ROTOR

NAI-PEI BI and J. G. LEISHMAN (Maryland, University, College Park) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 756-767. refs
(Contract DAAL03-88-C-0002; NAG2-607)
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An analysis was conducted on the unsteady pressures measured on a body surface in proximity to a rotor. Unsteady pressures were measured at strategic points on the body in forward flight at various combination of advance ratio, rotor thrust, and tip-path-plane angle. It was found that the local values of unsteady pressure were significantly altered by small changes in rotor thrust and advance ratio; tip-path-plane angle variations had a much smaller effect. Four characteristic pressure signatures representative of (1) blade passage, (2) close wake interactions with the body, (3) wake impingement on the body, and (4) postwake impingement were distinguished. These classifications were supported by correlations with shadowgraphic flow visualization of the rotor wake/body interaction, as well as unsteady potential flow models. This general classification of the surface pressure signatures has permitted a greater physical understanding of the overall air loads and possible mechanisms responsible for the interactional effects between a helicopter rotor and its fuselage. Author

A92-13213

COMPUTATION OF VECTORING NOZZLE PERFORMANCE

PATRICK L. CHEATHAM, STEVEN H. WALKER, and MARVIN C. GRIDLEY (USAF, Wright Research and Development Center, Wright-Patterson AFB, OH) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 768-773. Previously cited in issue 18, p. 2816, Accession no. A90-42225. refs

A92-13215* Purdue Univ., West Lafayette, IN.

AEROELASTIC ANALYSIS OF WINGS USING THE EULER EQUATIONS WITH A DEFORMING MESH

BRIAN A. ROBINSON, HENRY T. Y. YANG (Purdue University, West Lafayette, IN), and JOHN T. BATINA (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 781-788. Previously cited in issue 11, p. 1603, Accession no. A90-29376. refs
(Contract NAG1-372)
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A92-13216

ANALYSIS OF FLEXIBLE-MEMBRANE AND JET-FLAPPED AIRFOILS USING VELOCITY SINGULARITIES

D. MATEESCU and B. G. NEWMAN (McGill University, Montreal,

Canada) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 789-795. Research supported by NSERC. refs
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A method for predicting the flow past thin airfoils in incompressible potential flow is presented. This method makes use of special singularities that directly represent the complex conjugate perturbation velocity in the plane of the airfoil. The method is developed first for rigid cambered airfoils and is then extended to problems for which it is particularly suitable, namely, the flow past flexible impervious membranes and past airfoils with jet flaps. Author

A92-13217

FICKLE EFFECT OF NOSE MICROASYMMETRY ON THE HIGH-ALPHA AERODYNAMICS

LARS E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 796-799. Previously cited in issue 06, p. 753, Accession no. A90-19663. refs
Copyright

A92-13218

POSTSTALL AIRFOIL RESPONSE TO A PERIODIC FREESTREAM

RICHARD M. HOWARD (U.S. Naval Postgraduate School, Monterey, CA) and DAVID J. GWILLIAM, JR. Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 799, 800. Previously cited in issue 06, p. 799, Accession no. A91-19297. refs

A92-13233

BLADE DEFECT FORCE INVESTIGATION IN A COMPRESSOR CASCADE

KRZYSZTOF MAJKA (Koszalin, School of Engineering, Poland) Instytut Maszyn Przeplywowych, Prace (ISSN 0079-3205), no. 92, 1990, p. 87-97. refs
Copyright

The paper presents an experimental study of the blade defect forces in a compressor cascade end-wall boundary layer. The experiments were aimed at improving the general understanding of the end-wall flow field and experimentally verifying the concepts and assumptions underlying the turbomachine integral boundary layer theory. Author

A92-13234

AN ANALYSIS OF THE FLOW-PATTERN AT THE EXIT OF A SINGLE-STAGE TURBINE [ANALIZA PRZEPLYWU ZA WIENCOM WIRNIKOWYM STOPNIA TURBINOWEGO]

SLAWOMIR BEDNAREK, JANUSZ W. ELSNER, and MAREK TRZCINSKI (Czestochowa Technical University, Poland) Instytut Maszyn Przeplywowych, Prace (ISSN 0079-3205), no. 92, 1990, p. 99-112. In Polish. refs
Copyright

The paper presents distributions of the mean velocity, longitudinal turbulence intensity, and outlet angle behind a single-stage air turbine for different values of the velocity ratio u/C_{os} . It has been found that, for the constant pressure ratio in the stage, the variation of u/C_{os} within the range 0.45-0.65 strongly affects the rotor exit flow field, especially the radial distributions of the outlet angle. The results obtained may be used to verify the calculation methods of the turbine stages with cylindrical blades and to analyze the turbine stage flow characteristics. They may be also utilized for further experimental investigation of linear and annular blade cascade, as well as single- and multistage experimental turbines. Author

A92-13235

ESTIMATION OF THE SIZE OF SEPARATION ZONE IN A TURBINE STAGE UNDER SMALL LOAD [OCENA ROZLEGLOSCI STREFY ODERWANIA STRUMIENIA PRZY MALYCH OBCIAZENIACH STOPNIA TURBINOWEGO]

TADEUSZ CHMIELNIAK and HENRYK LUKOWICZ Instytut Maszyn Przeplywowych, Prace (ISSN 0079-3205), no. 92, 1990,

p. 113-124. In Polish. refs
Copyright

The paper presents a method of estimating the size of the flow separation zone in turbine stages which are not working under full load. The model of the phenomenon comprises exact equations of radial equilibrium for the axisymmetric flow of wet steam, equation of continuity, equation of state for the liquid and gas phase, and an adequately selected manner of defining the boundary conditions. The dissipative phenomena have been taken into consideration integrally. A general description of the algorithm is shown. In order to solve the equations, the Runge-Kutta method is employed. Results of calculations are presented. Author

N92-10006* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**MASS FLUX SIMILARITY FOR SLOTTED
TRANSONIC-WIND-TUNNEL WALLS**

JOEL L. EVERHART and SURESH H. GORADIA Washington
Aug. 1991 22 p
(NASA-TM-4281; L-16864; NAS 1.15:4281) Avail: NTIS HC/MF
A03 CSCL 01A

A discussion of the flow field measurements obtained in the vertical plane at several stations along the centerline of slots in two different longitudinally slotted wind tunnel walls is presented. The longitudinal and transverse components of the data are then transformed using the concept of flow similarity to demonstrate the applicability of the technique to the development of the viscous shear flow along and through a slotted wall of an airfoil tunnel. Results are presented showing the performance of the similarity transformations with variations in tunnel station, Mach number, and airfoil induced curvature of the tunnel free stream. Author

N92-10007 North Carolina State Univ., Raleigh.
**A COMPUTATIONAL AND EXPERIMENTAL INVESTIGATION
OF A THREE-DIMENSIONAL HYPERSONIC SCRAMJET INLET
FLOW FIELD Ph.D. Thesis**

SCOTT DOUGLAS HOLLAND 1991 679 p
Avail: Univ. Microfilms Order No. DA9123361

Since careful design of primary engine parts such as the inlet is necessary to exploit effectively the potential of propulsion-airframe integration, a combined computational and experimental parametric study of the internal aerodynamics of a generic 3-D side wall compression scramjet inlet configuration was performed. The study was designed to show the utility of computational fluid dynamics as a design tool in hypersonic inlet fluid fields, to provide a detailed account of the nature and structure of the internal flow interactions, and to provide a comprehensive surface property and flow field data base to determine the effects of contraction ratio, cowl position, and Reynolds number on the performance of a hypersonic scramjet inlet configuration. The work proceeded in several phases: the initial inviscid assessment of the internal shock structure, the preliminary computational parametric study, the coupling of the optimized configuration with the physical limitations of the facility, the wind tunnel blockage assessment, and the computational and experimental parametric study of the final configuration. A total of 256 channels of pressure data, including static pressure orifices, pilot pressures, and entrance and exit flow rates, along with oil flow and infrared thermography provided a detailed experimental description of the flow. Author

N92-10008* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**REFLECTION TYPE SKIN FRICTION METER Patent
Application**

PROMODE R. BANDYOPADHYAY, inventor (to NASA) (AS&M, Inc., Hampton, VA.) and LEONARD M. WEINSTEIN, inventor (to NASA) 8 Aug. 1991 11 p
(NASA-CASE-LAR-14520-1-SB; NAS 1.71:LAR-14520-1-SB;
US-PATENT-APPL-SN-743238) Avail: NTIS HC/MF A03 CSCL 01A

A housing block is provided having an upper surface conforming to the test surface of a model or aircraft. An oil film is supplied upstream of a transparent wedge window located in this upper

surface by an oil pump system located external to the housing block. A light source located within the housing block supplies a light beam which passes through this transparent window and is reflected back through the transparent window by the upper surface of the oil film to a photo-sensitive position sensor located within the housing. This position sensor allows the slope history of the oil film caused by and aerodynamic flow to be determined. The skin friction is determined from this slope history. Internally located mirrors augment and sensitize the reflected beam as necessary before reaching the position sensor. In addition, a filter may be provided before this sensor to filter the beam. NASA

N92-10009* National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION OF HYPERSONIC VISCOUS FLOW
FOR THE DESIGN OF H-2 ORBITING PLANE (HOPE-2)**

YUKIMITSU YAMAMOTO and TOSHIO AKIMOTO Jan. 1991
78 p In JAPANESE; ENGLISH summary
(NAL-TR-1093; ISSN-0389-4010) Avail: NTIS HC/MF A05

An unmanned winged vehicle for space transportation, the H-II Orbiting Plane (HOPE), is being studied. Hypersonic computational fluid dynamics (CFD) analyses were performed on the proposed HOPE 63 model, with the effects of Reynolds number, Mach number, angles of attack, and yaw angles. In order to use CFD for more practical design purposes, analyses of control surfaces and the gas jet are also discussed. The objectives were to: (1) demonstrate the numerical code's validity for aerothermodynamic heating; (2) investigate the applicability of CFD to control problems; and (3) utilize CFD as the main design tool of the HOPE configuration, i.e., utilize it as a numerical wind tunnel. Numerical simulations were conducted using the flux split upwind Navier-Stokes code, and results showed excellent agreement with heat transfer distribution experiments, thereby demonstrating the present code's validity. Author

N92-10010* Oak Ridge National Lab., TN.
**RECENT ADVANCES ON A FINITE ELEMENT ALGORITHM
FOR COMPUTATIONAL AERODYNAMICS:
TRANSONICS-HYPERSONICS**

J. D. FREELS, A. J. BAKER, and G. S. IANELLI (Tennessee Univ., Knoxville.) 1991 7 p Presented at the 4th International Symposium on Computational Fluid Dynamics, Davis, CA, 9-12 Sep. 1991
(Contract DE-AC05-84OR-21400)

(DE91-018176; CONF-9109257-1) Avail: NTIS HC/MF A02

A weak statement forms the theoretical basis for identifying the range of choices/decisions for constructing approximate solutions to the compressible Navier-Stokes equations. The Galerkin form is intrinsically non-dissipative, and a Taylor series analysis identifies the extension needed for shock capturing. Thereafter, the approximation trial space is constructed with compact support using a spatial domain semi-discretization into finite elements. An implicit temporal algorithm produces the terminal algebraic form, which is iteratively solved using a tensor product factorization quasi-Newton procedure. Computational results verify algorithm performance for a range of aerodynamics specifications. DOE

N92-10011* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**TRANSONIC AND SUPERSONIC EULER COMPUTATIONS OF
VORTEX-DOMINATED FLOW FIELDS ABOUT A GENERIC
FIGHTER**

AGA M. GOODSSELL and JOHN E. MELTON Nov. 1991 44 p
(NASA-TP-3156; A-90161; NAS 1.60:3156) Avail: NTIS HC/MF
A03 CSCL 01A

Flow fields about a generic fighter model were computed using FL057, a 3-D, finite volume Euler code. Computed pressure coefficients, forces, and moments at several Mach numbers (0.6, 0.8, 1.2, 1.4, and 1.6) are compared with wind tunnel data over a wide range of angles of attack in order to determine the applicability of the code for the analysis of fighter configurations. Two configurations were studied, a wing-body and a wing-body-chine. FL057 predicted pressure distributions, forces, and moments well

02 AERODYNAMICS

at low angles of attack, at which the flow was fully attached. The FLO57 predictions were also accurate for some test conditions once the leading edge vortex became well established. At the subsonic speeds, FLO57 predicted vortex breakdown earlier than that seen in the experimental results. Placing the chine on the forebody delayed the onset of bursting and improved the correlation between numerical and experimental data at the subsonic conditions. Author

N92-10015# Naval Postgraduate School, Monterey, CA.
**NUMERICAL INVESTIGATION OF THE EFFECT OF LEADING
EDGE GEOMETRY ON DYNAMIC STALL OF AIRFOILS M.S.**

Thesis

STEVEN P. GROHSMEYER Sep. 1990 180 p
(AD-A239949) Avail: NTIS HC/MF A09 CSCL 01/3

The dynamic stall of rapidly pitching and oscillating airfoils is investigated by the numerical solution of the full compressible unsteady two-dimensional Navier-Stokes equations using an alternating-direction-implicit scheme. The flow is assumed to be fully turbulent, and the turbulent stresses are modelled by the Baldwin-Lomax eddy viscosity model. Three airfoils (NACA 0012, NACA 0012-33, and NACA 0012-63) are analyzed for the purpose of examining the influence of leading-edge geometry on unsteady flow separation. It is found that a larger leading edge radius, thicker contouring of the forward part of the airfoil, or increasing reduced frequency results in delaying flow separation and formation of the dynamic stall vortex to a higher angle of attack, yielding higher peak Cl. Within the scope of this study, the pressure gradient encountered by the flow at initial separation is found to be independent of reduced frequency and freestream speed. The critical pressure gradient is dependent on leading edge radius and increases for decreasing leading edge radius. GRA

N92-10016# Air Force Academy, CO.
**DOWNWASH MEASUREMENTS ON A PITCHING
CANARD-WING CONFIGURATION Final Report, 16 Jun. 1990 -
15 Sep. 1991**

JOHN E. BURKHALTER 15 Sep. 1991 64 p
(Contract AF PROJ. 2307)
(AD-A239956; FJSRL-TR-91-0001) Avail: NTIS HC/MF A04
CSCL 01/1

Experimental wind tunnel tests were conducted using a splitter plate model of a two wing configuration oscillating through an unsteady pitch maneuver. Of primary interest were measurements of circulation lag on each wing and the downwash on the aft wing due to the forward wing. It was found that circulation lag associated with oscillating wings is independent of externally induced downwash flow fields but is dependent on the location of the pivot point for the wing or airfoil section, the starting and ending angle, and the angle of attack history. Downwash from a forward wing on an aft lifting surface can make a significant contribution to the lifting properties of the aft wing. The magnitude of these downwash forces are dependent on the forward wing normal force magnitudes and may enhance or degrade the potential of an aft wing to produce lift. The downwash induced in this case, however, is not synchronized with the circulation lag associated with the forward wing but the shift in the downwash curve is more or less synchronized with the circulation lag associated with the aft wing. Consequently a forward wing producing positive lift can produce upwash on an aft wing increasing its potential to produce lift. Enhancement of maneuverability for an aircraft can also be increased by placing the forward canard above the main wing lifting surface. GRA

N92-10975*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, VA.
**STATIC INTERNAL PERFORMANCE OF VENTRAL AND REAR
NOZZLE CONCEPTS FOR SHORT-TAKEOFF AND
VERTICAL-LANDING AIRCRAFT**

RICHARD J. RE and GEORGE T. CARSON, JR. Washington
Sep. 1991 71 p
(NASA-TP-3103; L-16902; NAS 1.60:3103) Avail: NTIS HC/MF
A04 CSCL 01/1

The internal performance of two exhaust system concepts applicable to single-engine short-take-off and vertical-landing tactical fighter configurations was investigated. These concepts involved blocking (or partially blocking) tailpipe flow to the rear (cruise) nozzle and diverting it through an opening to a ventral nozzle exit for vertical thrust. A set of variable angle vanes at the ventral nozzle exit were used to vary ventral nozzle thrust angle between 45 and 110 deg relative to the positive axial force direction. In the vertical flight mode the rear nozzle (or tailpipe flow to it) was completely blocked. In the transition flight mode flow in the tailpipe was split between the rear and ventral nozzles and the flow was vectored at both exits for aircraft control purposes through this flight regime. In the cruise flight mode the ventral nozzle was sealed and all flow exited through the rear nozzle. Author

N92-10976*# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, OH.

**RESULTS FROM COMPUTATIONAL ANALYSIS OF A MIXED
COMPRESSION SUPERSONIC INLET**

J. D. SAUNDERS and T. G. KEITH (Ohio Aerospace Inst., Brook Park.) 1991 18 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; sponsored by AIAA, SAE, ASME, and ASCE Previously announced in IAA as A91-45818 Original contains color illustrations (NASA-TM-104475; E-6322; NAS 1.15:104475; AIAA-91-2581) Copyright Avail: NTIS HC/MF A03; 5 functional color pages CSCL 01/1

A numerical study was performed to simulate the critical flow through a supersonic inlet. This flow field has many phenomena such as shock waves, strong viscous effects, turbulent boundary layer development, boundary layer separations, and mass flow suction through the walls, (bleed). The computational tools used were two full Navier-Stokes (FNS) codes. The supersonic inlet that was analyzed is the Variable Diameter Centerbody, (VDC), inlet. This inlet is a candidate concept for the next generation supersonic involved effort in generating an efficient grid geometry and specifying boundary conditions, particularly in the bleed region and at the outflow boundary. Results for a critical inlet operation compare favorably to Method of Characteristics predictions and experimental data. Author

N92-10979*# United Technologies Research Center, East Hartford, CT.

**DEVELOPMENT OF UNSTEADY AERODYNAMIC ANALYSES
FOR TURBOMACHINERY AEROELASTIC AND
AEROACOUSTIC APPLICATIONS**

JOSEPH M. VERDON, MARK BARNETT, KENNETH C. HALL,
and TIMOTHY C. AYER Washington NASA Oct. 1991
112 p
(Contract NAS3-25425)
(NASA-CR-4405; E-6528; NAS 1.26:4405; R91-957907-3) Avail:
NTIS HC/MF A06 CSCL 01/1

Theoretical analyses and computer codes are being developed for predicting compressible unsteady inviscid and viscous flows through blade rows. Such analyses are needed to determine the impact of unsteady flow phenomena on the structural durability and noise generation characteristics of turbomachinery blading. Emphasis is being placed on developing analyses based on asymptotic representations of unsteady flow phenomena. Thus, flow driven by small-amplitude unsteady excitations in which viscous effects are concentrated in thin layers are being considered. The resulting analyses should apply in many practical situations, lead to a better understanding of the relevant physics, and they will be efficient computationally, and therefore, appropriate for aeroelastic and aerodynamic design applications. Under the present phase (Task 3), the effort was focused on providing inviscid and viscous prediction capabilities for subsonic unsteady cascade flows. Author

N92-10980# National Aerospace Lab., Tokyo (Japan). Airframe Div.

**UNSTEADY AERODYNAMIC CALCULATIONS FOR GENERAL
CONFIGURATIONS BY THE DOUBLE-POINT METHOD**

TETSUHIKO UEDA Apr. 1991 31 p In JAPANESE; ENGLISH summary

(NAL-TR-1101T; ISSN-0389-4010) Avail: NTIS HC/MF A03

A method for predicting unsteady aerodynamic loadings on general configurations is presented. The procedures are based on the lifting surface theory, with the time variable being transformed to the Laplace domain so that the calculation is valid in the region of off axis from the frequency domain. The results are subsequently compared with those from other methods and experiments in both the subsonic and supersonic frequency domains. In addition, a generalized force is calculated in the Laplace domain for a rectangular wing in supersonic flow. Author

N92-10981*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

NACA 0015 WING PRESSURE AND TRAILING VORTEX MEASUREMENTS

K. W. MCALISTER and R. K. TAKAHASHI Washington Nov. 1991 141 p

(NASA-TP-3151; A-91056; NAS 1.60:3151;

AVSCOM-TR-91-A-003) Avail: NTIS HC/MF A07 CSCL 01/1

A NACA 0015 semispan wing was placed in a low-speed wind tunnel, and measurements were made of the pressure on the upper and lower surface of the wing and of velocity across the vortex trailing downstream from the tip of the wing. Pressure data were obtained for both 2-D and 3-D configurations. These data feature a detailed comparison between wing tips with square and round lateral edges. A two-component laser velocimeter was used to measure velocity profiles across the vortex at numerous stations behind the wing and for various combinations of conditions. These conditions include three aspect ratios, three chord lengths, a square- and a round lateral-tip, presence or absence of a boundary-layer trip, and three image plane positions located opposite the wing tip. Both pressure and velocity measurements were made for the angles of attack 4 deg less than or equal to alpha less than or equal to 12 deg and for Reynolds numbers 1×10^6 (exp 6) less than or equal to Re less than or equal to 3×10^6 (exp 6). Author

N92-10982*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

VISCOUS COMPUTATIONS OF COLD AIR/AIR FLOW AROUND SCRAMJET NOZZLE AFTERBODY

OKTAY BAYSAL and WALTER C. ENGELUND Washington NASA Oct. 1991 73 p

(Contract NAG1-811)

(NASA-CR-4406; NAS 1.26:4406) Avail: NTIS HC/MF A04 CSCL 01/1

The flow field in and around the nozzle afterbody section of a hypersonic vehicle was computationally simulated. The compressible, Reynolds averaged, Navier Stokes equations were solved by an implicit, finite volume, characteristic based method. The computational grids were adapted to the flow as the solutions were developing in order to improve the accuracy. The exhaust gases were assumed to be cold. The computational results were obtained for the two dimensional longitudinal plane located at the half span of the internal portion of the nozzle for over expanded and under expanded conditions. Another set of results were obtained, where the three dimensional simulations were performed for a half span nozzle. The surface pressures were successfully compared with the data obtained from the wind tunnel tests. The results help in understanding this complex flow field and, in turn, should help the design of the nozzle afterbody section. Author

N92-10983*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

EXPERIMENTAL STUDY OF AN INDEPENDENTLY DEFLECTED WINGTIP MOUNTED ON A SEMISPAN WING

D. M. MARTIN (Kansas Univ. Center for Research, Inc., Lawrence.) and L. A. YOUNG Sep. 1991 58 p

(NASA-TM-102842; A-90210; NAS 1.15:102842) Avail: NTIS HC/MF A04 CSCL 01/1

The results of a subsonic wind tunnel test of a semispan wing

with an independently deflected tip surface are presented and analyzed. The tip surface was deflected about the quarter chord of the rectangular wing and accounted for 17 percent of the wing semispan. The test was conducted to measure the loads on the tip surface and to investigate the nature of aerodynamic interference effects between the wing and the deflected tip. Results are presented for two swept tip surfaces of similar planform but different airfoil distributions. The report contains plots of tip lift, drag, and pitching moment for various Reynolds numbers and tip deflection angles with respect to the inboard wing. Oil flow visualization photographs for a typical Reynolds number are also included. Important aerodynamic parameters such as lift and pitching moment slopes and tip aerodynamic center location are tabulated. A discussion is presented on the relationship between tip experimental data acquired in a steady flow and the prediction of unsteady tip motion at fixed wing angles of attack. Author

N92-10985# West Virginia Univ., Morgantown. Dept. of Mechanical and Aerospace Engineering.

EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF BLOWING ON BURSTING OF STRAKE VORTICES Final Technical Report, 12 Jul. 1989 - 22 Apr. 1991

ROBERT ALLEN ROACH and JOHN M. KULHMAN Jul. 1991 177 p

(Contract F33615-89-C-3001)

(AD-A240256; WL-TR-91-3065) Avail: NTIS HC/MF A09 CSCL 01/1

Laser light sheet flow visualization and laser Doppler Anemometry (LDA) have been utilized to study the effects of pneumatic jet blowing on the breakdown and coupling locations of the strake and wing vortices generated over a generic fighter aircraft model with 55 degree sweep cropped delta wing planform fitted with forebody strakes. Experiments were conducted at low speed (15 m/sec), corresponding to a chord Reynolds number of 270,000, over an angle of attack range of 20 to 36 degrees. Flow visualization has been used to determine jet blowing locations and nozzle configurations which have the maximum beneficial effects of delaying both vortex breakdown and coupling of the strake and wing vortices. Significant reductions were observed both in vortex coupling interaction and in strake vortex breakdown at a blowing coefficient referenced to the wing area of 0.016. The LDA data indicated increases in the mean axial velocity above the vortices and increased turbulent velocities due to jet blowing. GRA

N92-10986# Wright Lab., Wright-Patterson AFB, OH.

SUBSONIC WIND TUNNEL TESTING HANDBOOK Interim Report, 1 May 1990 - 1 May 1991

MICHAEL G. ALEXANDER May 1991 296 p

(Contract AF PROJ. 2404)

(AD-A240263; WL-TR-91-3073) Avail: NTIS HC/MF A13 CSCL 14/2

This handbook is predominantly structured for subsonic (noncompressible flow), force and moment wind tunnel testing. Its purpose is to provide to the aerodynamic testing engineer equations, concepts, illustrations, and definitions that would aid him or her in wind tunnel testing. The information in this handbook is a living document readily expandable to include personal notes and additional sections. This handbook has not and cannot encompass every wind tunnel testing technique or principle. GRA

N92-10989# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.

THREE DIMENSIONAL NUMERICAL METHOD FOR RESOLVING SMALL TRANSONIC PERTURBATIONS IN UNSTRUCTURED MESH Final Report (METHODE NUMERIQUE 3D DE RESOLUTION DES PETITES PERTURBATIONS TRANSSONNIQUES EN MAILLAGE NON STRUCTURE. RAPPORT FINAL)

F. BANGUI Feb. 1991 63 p In FRENCH

02 AERODYNAMICS

(Contract DRET-89-34-001)

(ONERA-RT-56/3064-RY-006-R; ETN-91-90096) Avail: NTIS HC/MF A04

A resolution method for Euler equations in small transonic perturbations is presented. Theoretical developments to substitute to the hyperbolic type problem a discretized elliptic type problem by finite element method are reviewed. The algebra of boundary conditions on the moving parts is presented. Steady and unsteady numerical applications are given. ESA

N92-10990*# Stanford Univ., CA. Dept. of Aeronautics and Astronautics.

COMPUTATIONAL STUDY OF THE AERODYNAMICS AND CONTROL BY BLOWING OF ASYMMETRIC VORTICAL FLOWS OVER DELTA WINGS

KEN CRAIG Sep. 1991 38 p Sponsored by NASA. Ames Research Center

(NASA-CR-187979; NAS 1.26:187979; JIAA-TR-104) Avail: NTIS HC/MF A03 CSCL 01/1

Some of the work is described which was done in a study of the flow field produced by tangential leading edge blowing on a 60 deg. delta wing. The flow is studied computationally by solving the Thin Layer Navier-Stokes equations. Steady state flow fields are calculated for various angles of attack and yaw, with and without the presence of tangential leading edge blowing. The effectiveness of blowing as a rolling moment control mechanism to extend the envelope of controllability is illustrated at pre- and post-stall angles of attack. The numerical grid is generated using algebraic grid generation and various interpolation and blending techniques. The jet emanates from a slot with linearly varying thickness and is introduced into the flow field using the concept of an actuator plane, thereby not requiring resolution of the jet slot geometry. The Baldwin-Lomax algebraic turbulence model is used to provide turbulent closure. The computational results are compared with those of experiments. Author

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A92-10257

FLAMMABILITY, SMOKE AND TOXIC GAS COMBUSTION PRODUCTS OF COMPOSITES USED IN AIRCRAFT CABINS

JAMES M. PETERSON (Boeing Commercial Airplane Group, Seattle, WA) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1890-1899. Copyright

The fire properties of materials used in aircraft cabins are rigorously controlled by regulatory bodies such as the FAA. In addition, supplemental unilateral fire property controls are required by the aircraft manufacturers. There is constant pressure from the regulators and from the manufacturers to continuously upgrade these materials. The requirements imposed by the regulatory bodies and by the manufacturers on aircraft cabin materials, and the current material types typically used are discussed. Author

A92-11014#

HUNTING PHENOMENA OF THE BALLOON MOTIONS OBSERVED OVER ANTARCTICA

JUN ISHIMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 83-88. refs (AIAA PAPER 91-3667) Copyright

It was reported that strong hunting motions were observed just after reaching the ceiling altitude for the balloons launched in Antarctica in the daytime. Such hunting motions have been observed over midlatitudes only for night time launching. In this paper, the thermal analysis of the balloon motions is performed by considering the atmospheric temperature and environmental radiation conditions at balloon altitudes. It is found that the hunting phenomena in summer season are caused by the fact that the balloons over Antarctica encounter similar thermal conditions to those flights at night over the midlatitudes. Author

A92-11016#

BALLOON ALTITUDE CONTROL BY VALVING - A REVIEW AND COMPARISON OF ACTUAL FLIGHT DATA AND VERTICAL PERFORMANCE ANALYSIS RESULTS

G. D. ORR and EDWARD V. FRITSCH (National Scientific Balloon Facility, Palestine, TX) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 94-100. refs (AIAA PAPER 91-3669) Copyright

This paper describes an effort to establish a method to quantitatively predict the effect of valving on balloon vertical trajectory. The flow coefficient, $C(0)$, in a simple equation borrowed from hydraulic analysis is proposed as a means to develop the predictive method. A range of $C(0)$ is established for the standard EV-13 helium valve using actual flight records and a trajectory fitting method which employs NASA's SINBAD computational model. Available laboratory flow test data on the EV-13 valve is also examined. Relationships between $C(0)$ and several flight variables are explored. Author

A92-11018*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.

OVERPRESSURIZED ZERO PRESSURE BALLOON SYSTEM

JOEL M. SIMPSON (NASA, Wallops Flight Center, Wallops Island, VA) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 108-115. refs

(AIAA PAPER 91-3671) Copyright

Typical zero pressure scientific balloon systems experiencing diurnal cycles require on board expendable ballast to maintain design float altitude. In the past, pressurized balloon systems have been employed to overcome the need for ballast while maintaining small diurnal altitude excursions. However, requirements on material characteristics and manufacturing methods have enforced limitations on balloon size and therefore payload and altitude capabilities. This effort was aimed at considering the use of current (or slightly modified) zero pressure balloon systems (design, manufacturing and materials) as candidates for pressurized vehicles. Data gathered through performance analysis, structural analysis and flight testing has shown that the use of current zero pressure designs can be expanded to enhance balloon performance. Author

A92-11019*# Washington Univ., Seattle.

STRATOSPHERIC ELECTRODYNAMICS FROM SUPERPRESSURE BALLOONS - A TECHNICAL CHALLENGE FOR SMALL PAYLOAD ENVIRONMENTS

R. H. HOLZWORTH, K. W. NORVILLE, H. HU (Washington, University, Seattle), R. L. DOWDEN, C. D. D. ADAMS (Otago, University, Dunedin, New Zealand), W. D. GONZALEZ, and O. PINTO, JR. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 125-132. refs (Contract NAG5-668; NSF ATM-89-20428) (AIAA PAPER 91-3674) Copyright

The state-of-the-art in stratospheric balloon-borne vector electric field measurements, from its origins to the present is reviewed. Consideration is given to the Extended Life Balloon-Borne

Observatories program that utilizes an extensively modified payload and dual telemetry systems to improve the measurements and increase the data rates. R.E.P.

A92-11020#**MANNED ORBITAL BALLOON FLIGHT - AVAILABLE TECHNIQUES**

VINCENT E. LALLY (NCAR, Boulder, CO) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 133-142.

(AIAA PAPER 91-3675) Copyright

The atmospheric radiation conditions are the critical parameter for long-duration balloon flight. The radiation environment which will be experienced by a globe-circling balloon is described. Technologies for achieving manned-orbital flight are the superpressure balloon and the Anchor balloon. Flight simulations are provided for the earthwinds gondola, utilizing the two techniques. Author

A92-11023#**LONG DURATION BALLOONING IN ANTARCTICA - AN OPERATIONAL PERSPECTIVE**

D. R. J. BALL (National Scientific Balloon Facility, Palestine, TX) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 158-164. refs

(AIAA PAPER 91-3679) Copyright

In December, 1990 a very large helium filled balloon was launched from Williams Field in Antarctica. The balloon was the first to circumnavigate the continent, traveling four thousand miles at altitudes in excess of 120,000 feet over a period of nearly 9 days. The flight was terminated only 113 nautical miles from the launch site. Operational aspects of the flight are reviewed along with a general discussion of long duration ballooning in Antarctica. Author

A92-11024*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.

THE NASA LONG DURATION BALLOON PROJECT

DAVID STUCHLIK (NASA, Wallops Flight Center, Wallops Island, VA) and KEVIN TILLERY (New Mexico State University, Las Cruces) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 165-169.

(AIAA PAPER 91-3680) Copyright

A review is presented of the long duration balloon (LDB) project to develop a near-global capability for both Antarctica and midlatitude applications. This project would include the systems required to conduct flights of scientific experiments weighing 1500 lb or more on conventional balloons for periods up to three weeks. The objective of this program is to satisfy approved support requirements for experimenters conducting scientific tests from free-floating high-altitude balloons. R.E.P.

A92-11025#**A VALVE-DOWN TECHNIQUE FOR SMALL BALLOONS**

N. T. KJOME (Wyoming, University, Laramie) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 170-172. Research supported by NSF. refs

(AIAA PAPER 91-3681) Copyright

This paper describes an automatic valve-down technique which has been developed to provide a slow, controlled descent from high altitude using a small plastic sounding balloon. With this technique one may obtain a high-resolution vertical profile of atmospheric parameters free of possible contamination from the balloon. A typical descent profile is supplied from a flight made in the arctic winter. Author

A92-11026#**SMALL BALLOON BALLISTIC TRACING AND BEHAVIOR ANOMALIES**

JOHN R. GROUND (USAF, Phillips Laboratory, Hanscom AFB, MA) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 173-180.

(AIAA PAPER 91-3682)

A balloon tracking and meteorological data gathering system was developed for small free floating balloons. The evolution and test of this system and several small balloon flights are described. Balloons of different volumes were flown at several altitudes, varying durations and times of day. Position, pressure-altitude and temperature data from these flights were closely monitored. These data have been correlated with cloud cover, terrain, and diurnal changes. Data from the July 1990 flight series are described in the greatest detail. Author

A92-11027#**KESTREL BALLOON LAUNCH SYSTEM**

M. J. NEWMAN (Lawrence Livermore National Laboratory, Livermore, CA) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 181-188.

(Contract W-7405-ENG-48)

(AIAA PAPER 91-3684)

Kestrel is a high-altitude, Helium-gas-filled-balloon system used to launch scientific payloads in winds up to 20 knots, from small platforms or ships, anywhere over land or water, with a minimal crew and be able to hold in standby conditions. Its major components consist of two balloons (a tow balloon and a main balloon), the main deployment system, helium measurement system, a parachute recovery unit, and the scientific payload package. The main scope of the launch system was to eliminate the problems of being dependent of launching on long airfield runways, low wind conditions, and long launch preparation time. These objectives were clearly met with Kestrel 3. Author

A92-11030#**DESIGN OF A TRANS-GLOBAL MANNED BALLOON SYSTEM WITH RELEVANCE TO SCIENTIFIC BALLOONING**

T. T. LACHENMEIER (Raven Industries, Inc., Sioux Falls, SD) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 199-204. refs

(AIAA PAPER 91-3687) Copyright

The paper discusses the major features of a balloon system designed for the project EarthWinds. The projects mission is to make the first non-stop transglobal balloon flight in a non-powered manned balloon. The design uses a zero-pressure polyethylene balloon combined with a superpressure anchor balloon and cryogenic helium replenishment to meet the mission requirements. Building on past experience a more robust anchor balloon was developed using composite construction and a new material called Spectra. Zero-pressure balloons using cryogenic helium replenishment can gain ballast efficiencies of more than 3:1 along with greater altitude stability. Specifications and performance test data for the cryogenic system is provided. Improved altitude control can be achieved through both the passive and active operation of the anchor balloon. A successful prototype flight validated the design concept. Author

A92-11031#**POLAR PATROL BALLOON**

T. HIRASAWA, M. EJIRI, R. FUJII, A. KADOKURA (National Institute of Polar Research, Tokyo, Japan), J. NISHIMURA, N. YAJIMA, M. AKIYAMA, T. YAMAGAMI, S. OHOTA (Institute of Space and Astronautical Science, Sagami, Japan), and S. KOKUBUN (Tokyo, University, Japan) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10,

03 AIR TRANSPORTATION AND SAFETY

1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 205-208. refs (AIAA PAPER 91-3688) Copyright

From late December of 1990 to early January of 1991, the National Institute of Polar Research, in collaboration with the Institute of Space and Astronautical Science, launched two large zero-pressure balloons from Syowa Station which is the Japanese research base in Antarctica. The balloon launched on December 25 returned near Syowa Station after 15 days of flight keeping the constant altitude of about 30 km. It finally accomplished almost a one and half a circumpolar flight. The total flight duration was about 40 days. This paper will describe the balloon system and the flight behavior of the balloon. Author

A92-11032#

AN AIR-LAUNCHED BALLOON SYSTEM FOR A 230 LB GROSS INFLATION

K. H. HAZLEWOOD (Southwest Research Institute, San Antonio, TX) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 209-214. Research supported by USAF. refs (AIAA PAPER 91-3689)

An approach for air launching a 230 lb gross lift system is under development and will culminate in a proof-of-concept flight. This development is for a specific payload, but the concept is applicable to many combinations of payload, balloon, and free-lift that total 230 lb, and that fit into certain size constraints. The system is being developed for an earth atmosphere, but it may be applicable to the atmospheres of other planets. Each subsystem of the concept is discussed, along with its associated problems and the approach used. Author

A92-11033#

RECENT DEVELOPMENTS IN THE USE OF THIN-FILM POLYETHYLENE BALLOONS FOR METEOROLOGICAL APPLICATIONS

TIM W. MARKHARDT (Raven Industries, Inc., Sioux Falls, SD) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 215, 216. Copyright

Prompted by the availability of reliable thin polyethylene films (6 - 9 microns), a balloon has been developed which provides more dependable high altitude data for meteorological soundings than a latex balloon. The performance of these balloons is presently being verified by users in both the Arctic and the Antarctic regions. Data is presented which examines the rise rate and ultimate altitude performance of the balloon. Author

A92-11034#

ADDED MASS OF HIGH-ALTITUDE BALLOONS

W. J. ANDERSON (Michigan, University, Ann Arbor) and GOURANG SHAH IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 217-222. refs (AIAA PAPER 91-3693) Copyright

A study using the theory of acoustics to develop the added mass for several rigid, immersed bodies is presented. A numerical solution based on boundary elements is used and the classical cases of a circular disk and a sphere are employed to determine the mesh fineness required for engineering accuracy. The specific inertia coefficients determined for high altitude balloons will help in developing flight simulation codes that model dynamic balloon behavior. R.E.P.

A92-11170

REQUIREMENTS FOR AN AIRCRAFT MISHAP ANALYSIS SYSTEM

JOHN F. COURTRIGHT (BDM International, Inc., Albuquerque, NM) IN: Human Factors Society, Annual Meeting, 34th, Orlando,

FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1047-1051. refs (Contract F33615-86-D-0554) Copyright

The Aircraft Mishap Prevention (AMP) program is described which is designed to facilitate understanding of the extent and nature of human contribution to aircraft accidents. The program focuses on gathering data on factors such as equipment design, training, and operational practices, as well as analyzing corresponding deficiencies. Particular attention is given to the analysis of human factors in the AMP investigations; special software and staff are incorporated to study human factors in individual mishaps and in all mishaps. The analysis tools and the staff dedicated to interpreting the role of human factors can provide the AMP with the ability to employ statistics and modeling to quantify human contribution to aircraft mishaps. The results can provide the basis for developing countermeasures for mishaps including those for design, training, and operation. C.C.S.

A92-11171* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PRE-FLIGHT RISK ASSESSMENT IN EMERGENCY MEDICAL SERVICE (EMS) HELICOPTERS

ROBERT J. SHIVELY (NASA, Ames Research Center; U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1052-1056. refs Copyright

A preflight risk assessment system (SAFE) was developed at NASA-Ames Research Center for civil EMS operations to assist pilots in making a decision objectively to accept or decline a mission. The ability of the SAFE system to predict risk profiles was examined at an EMS operator. Results of this field study showed that the usefulness of SAFE was largely dependent on the type of mission flown. R.E.P.

A92-11172* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ANALYSIS OF GENERAL AVIATION ACCIDENTS DURING OPERATIONS UNDER INSTRUMENT FLIGHT RULES

C. T. BENNETT (NASA, Ames Research Center; U.S. Army, Moffett Field, CA), MARTIN SCHWIRZKE, and C. HARM (San Jose State University, CA) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1057-1061. refs Copyright

A report is presented to describe some of the errors that pilots make during flight under IFR. The data indicate that there is less risk during the approach and landing phase of IFR flights, as compared to VFR operations. Single-pilot IFR accident rates continue to be higher than two-pilot IFR incident rates, reflecting the high work load of IFR operations. R.E.P.

A92-11178

COCKPIT DISTRACTIONS - PRECURSORS TO EMERGENCIES

VALERIE E. BARNES (Battelle Human Affairs Research Centers, Seattle, WA) and WILLIAM P. MONAN (Battelle's Aviation Safety Reporting System Office, Mountain View, CA) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1142-1144. refs Copyright

The promulgated the 'Sterile Cockpit Rule' in mid-1981 in order to reduce incidents resulting from distractions occurring in the cockpit during critical phase of flight below 10,000 feet. The rule was, in part, a response to the large number of reports submitted to NASA's Aviation Safety Reporting System (ASRS) that indicated that nonsafety-related activities had diverted flight crews' attention from their primary flight duties. In this paper, more recent ASRS reports are discussed. These reports indicate that distraction incidents below 10,000 feet have continued to occur since the

rule was promulgated. The sources of distraction identified in the sample of ASRS reports are also discussed. Author

A92-11379* State Univ. of New York, Brockport.
EVALUATION OF A TECHNIQUE TO QUANTIFY MICROBURST WINDSHEAR HAZARD POTENTIAL TO AIRCRAFT
 G. P. BYRD (Brockport, State University College, NY), F. H. PROCTOR (Meso, Inc., Hampton, VA), and R. L. BOWLES (NASA, Langley Research Center, Hampton, VA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 689-694. refs
 Copyright

A wind shear hazard index, known as the F-factor, is investigated for application with look-ahead sensors. Based on data from microburst simulations with the NASA windshear model, the downdraft results in a significant contribution to the wind shear hazard, especially at altitudes above 150 meters. Since most look-ahead wind shear sensors can only detect horizontal shear and cannot measure vertical velocity, a relationship is developed for approximating the total F-factor using information based solely on the horizontal wind shear and altitude. This relationship is then tested using data from several microburst cases. I.E.

A92-11380* Washington State Univ., Pullman.
A DFW MICROBURST MODEL BASED ON DL-191 DATA
 WALTER J. GRANTHAM (Washington State University, Pullman) and EDWIN K. PARKS (Arizona, University, Tucson) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 695-701. refs
 (Contract NCA2-216; NCC2-329)
 Copyright

Analysis of the August 2, 1985 crash of an L-1011 jumbo jet (DL-191), on approach to the Dallas-Ft. Worth International Airport (DFW) in a thunderstorm indicates that the severe windshear microburst which caused the crash was composed not only of a strong downflow and outflow but also included several large-scale vortex rings entrained in the flowfield. A detailed two-dimensional model of the DFW microburst, based on data from DL-191, is presented. The model uses wind vector and flight path data reconstructed by NASA-Ames Research Center from the L-1011's digital flight data records and ground-based radar measurements. The model was developed using a combination of interactive graphics and a least-square-error best fit between the modeled and measured wind vectors along the DL-191 flight path. The model confirms a microburst structure based on a von Karman vortex street rather than on a Kelvin-Helmholtz instability and indicates that the L-1011 flew near or directly through several strong vortices. In addition, the results also confirm that the reconstructed wind vector data contain a time lag in the horizontal winds. For the DL-191 this lag is approximately three seconds. I.E.

A92-11382* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
WINDSHEAR DETECTION AND AVOIDANCE - AIRBORNE SYSTEMS SURVEY
 ROLAND L. BOWLES (NASA, Langley Research Center, Hampton, VA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 708-736. refs
 Copyright

Functional requirements for airborne windshear detection and warning systems are discussed in terms of the threat posed to civil aircraft operations. A preliminary set of performance criteria for predictive windshear detection and warning systems is defined. Candidate airborne remote sensor technologies based on microwave Doppler radar, Doppler laser radar (lidar), and infrared radiometric techniques are discussed in the context of overall system requirements, and the performance of each sensor is assessed for representative microburst environments and ground clutter conditions. Preliminary simulation results demonstrate that

all three sensors show potential for detecting windshear, and provide adequate warning time to allow flight crews to avoid the affected area or escape from the encounter. Radar simulation and analysis show that by using bin-to-bin automatic gain control, clutter filtering, limited detection range, and suitable antenna tilt management, windshear from wet microbursts can be accurately detected. Although a performance improvement can be obtained at higher radar frequency, the baseline X-band system also detected the presence of windshear hazard for a dry microburst. Simulation results of end-to-end performance for competing coherent lidar systems are presented. I.E.

A92-12749#
THE BACKGROUND AND THE DEVELOPMENT OF THE TAL-WAR (ROSE) SHAPE BLIMP WITH THE ARTICULATED THRUSTER
 ATILLA M. TALUY (Taluy Co., Oxnard, CA) AIAA, International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991. 11 p. refs
 (AIAA PAPER 91-3692) Copyright

The lighter-than-air technology for a small, remotely controlled, fiber-optic-linked blimp is discussed with attention given to the development of the TAL-WAR shape and the articulated thruster. Theoretical, aerodynamic, and wind-tunnel considerations are reviewed, and a proof-of-concept model is presented. The TAL-WAR shape is mathematically definable and can be efficiently manufactured, and the configuration has a low drag coefficient, stable aerodynamics, and light weight. C.C.S.

A92-13025
FATIGUE AND ACCIDENTS - A COMPARISON ACROSS MODES OF TRANSPORT
 NICK McDONALD, RAY FULLER (Trinity College, Dublin, Republic of Ireland), and GEORGE WHITE (Ryanair, Ltd., Dublin, Republic of Ireland) IN: Stress and error in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 125-133. refs
 Copyright

Fatigue figures prominently in confidential reporting systems for aviation incidents. Evidence from epidemiological studies of accidents in different modes of transport demonstrates a strong influence of working hours, time of day and disruption of sleep, as well as some ultradian and hebdomadal factors. Differences between the different transportation modes would not seem to invalidate cross-modal comparisons, though there are major gaps in the evidence, particularly in relation to influences which extend beyond 24 hours, time-zone changes, and social and organizational factors in the management of fatigue. Author

N92-10017*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FEASIBILITY OF USING A KNOWLEDGE-BASED SYSTEM CONCEPT FOR IN-FLIGHT PRIMARY FLIGHT DISPLAY RESEARCH
 WENDELL R. RICKS Sep. 1991 19 p Previously announced as A91-19335
 (NASA-TM-4279; L-16917; NAS 1.15:4279) Avail: NTIS HC/MF A03 CSCL 01/3

A study was conducted to determine the feasibility of using knowledge-based systems architectures for inflight research of primary flight display information management issues. The feasibility relied on the ability to integrate knowledge-based systems with existing onboard aircraft systems. And, given the hardware and software platforms available, the feasibility also depended on the ability to use interpreted LISP software with the real time operation of the primary flight display. In addition to evaluating these feasibility issues, the study determined whether the software engineering advantages of knowledge-based systems found for this application in the earlier workstation study extended to the inflight research environment. To study these issues, two integrated knowledge-based systems were designed to control the primary flight display according to pre-existing specifications of an ongoing primary flight display information management research effort. These two systems were implemented to assess the feasibility

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and software engineering issues listed. Flight test results were successful in showing the feasibility of using knowledge-based systems inflight with actual aircraft data. Author

N92-10018# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

A COMPARISON BETWEEN THE CONSEQUENCES OF THE LIBERAL AND NON-LIBERAL UK-EUROPE BILATERALS
ROBERT CAVES and CHRISTOPHER HIGGINS May 1991 36 p
(TT-9101; ISBN-0-904947-30-0; ETN-91-99891) Copyright
Avail: NTIS HC/MF A03

The history of newly liberalized routes between the UK (United Kingdom) and the continent of Europe is examined. Through this examination it is hoped that the value of competition for the consumer will be established and a basis for estimating the impacts of further European Economic Community (EEC) induced liberalization on traffic and route structures will be provided.

ESA

N92-10019# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.

THE 1990 AIRPORT SURVEILLANCE RADAR WIND SHEAR PROCESSOR (ASR-WSP) OPERATIONAL TEST AT ORLANDO INTERNATIONAL AIRPORT

T. A. NOYES, S. W. TROXEL, M. E. WEBER, O. J. NEWELL, and J. A. CULLEN 17 Jul. 1991 68 p
(Contract F19628-90-C-0002; DTFA-01-L-83-4-10579)
(AD-A239852; ATC-178; DOT/FAA/NR-91/1) Avail: NTIS HC/MF A04 CSCL 17/9

Lincoln Laboratory, under sponsorship from the Federal Aviation Administration (FAA), is conducting a program to evaluate the capability of the newest Airport Surveillance Radars (ASR-9) to detect hazardous weather phenomena--in particular, low-altitude wind shear created by thunderstorm-generated microbursts and gust fronts. The ASR-9 could provide coverage at airports not slated for a dedicated Terminal Doppler Weather Radar (TDWR) and could augment the TDWR at high-priority (high traffic volume, severe weather) facilities by providing a more rapid update of wind shear products, a better viewing angle for some runways, and redundancy in the event of a TDWR failure. An operational evaluation of a testbed ASR Wind Shear Processor (ASR-WSP) was conducted at the Orlando International Airport in Orlando, FL during August and September 1990. The ASR-WSP operational system issued five distinct products to Air Traffic Control: microburst detections, gust front detections, gust front movement predictions, precipitation reflectivity and storm motion. This document describes the operational system, the operational products, and the algorithms employed. An assessment of system performance is provided as one step in evaluating the operational utility of the ASR-WSP.

Author (GRA)

N92-10991# California Univ., Berkeley. Air Transportation Technology Center.

PERSONAL AIR TRANSPORT: STATE OF THE ART Final Report

DAVID D. LITTLE Apr. 1991 25 p Sponsored by California State Dept. of Transportation
(PB91-204768; CA/TL-91-03) Avail: NTIS HC/MF A03 CSCL 01/3

As congestion on roadways and at airports continues to increase and the cost of capacity expansion becomes prohibitive, new ways of addressing personal transportation needs have to be considered. Addressed here is the state of the art in Personal Air Transport (PAT), commonly referred to as the flying automobile. It is concluded that the PAT technology faces a number of technical, mechanical, regulatory, cost, and perception obstacles in its attempt to become economically feasible. No one of the obstacles appears to be insurmountable, but the combination of obstacles could keep PAT from significantly impacting the personal transportation market. Author

N92-10992# Federal Aviation Administration, Atlantic City, NJ.
PROGRAM PLAN: NATIONAL AGING AIRCRAFT RESEARCH PROGRAM

Sep. 1991 54 p
(DOT/FAA/CT-88/32-1) Avail: NTIS HC/MF A04

The inevitable effects of aircraft aging are progressive increases in the probability of damage from fatigue corrosion. The continued safe operation of the U.S. commercial fleet will depend on the ability to anticipate required adjustments in the inspection and maintenance activities to compensate for the aging process. Increasing numbers of aircraft are exceeding their economic design life. Presumably, commercial aircraft are designed for infinite life with proper maintenance, but public confidence in operators' abilities to properly maintain older aircraft significantly diminished following the widely publicized failure of the Aloha Airlines 737 fuselage in 1988. The FAA established the National Aging Aircraft Research Program (NAARP) to address this diminished public confidence in the airlines' ability to properly maintain their older aircraft. The goal is to assure continued airworthiness of the U.S. commercial fleet of in-service and future aircraft beyond their economic design life. This will be achieved through improvements in equipment, techniques, practices, and procedures in aircraft and engine design, repair, maintenance, and inspection. The FAA will identify and direct the research to reach this goal. The results of the program will include a technical information data base that will be used by the FAA and/or industry to update or develop new rules, standards, advisories, and facilities. Author

N92-10993# Systems Control Technology, Inc., Arlington, VA.
GUIDELINES FOR INTEGRATING HELICOPTER ASSETS INTO EMERGENCY PLANNING Final Report

SANDRA HENNINGER, JACK THOMPSON, and CATHERINE ADAMS (Advanced Aviation Concepts, Jupiter, FL.) Jul. 1991 66 p

(Contract DTFA01-87-C-00014)
(SCT-91RR-18; DOT/FAA/RD-90/11) Avail: NTIS HC/MF A04

The guidelines are presented which contain recommendations on how to best integrate helicopters into existing emergency planning in order to provide maximum protection and life saving services in the community. Further information is provided on developing an inventory of helicopter resources; surveying helicopter operators capabilities; determining communication capabilities and requirements; designating, establishing, and controlling landing zones; and implementing a planned helicopter response. Author

N92-10994*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A COMPARISON OF AIRBORNE WAKE VORTEX DETECTION MEASUREMENTS WITH VALUES PREDICTED FROM POTENTIAL THEORY

ERIC C. STEWART Washington Nov. 1991 38 p
(NASA-TP-3125; L-16899; NAS 1.60:3125) Avail: NTIS HC/MF A03 CSCL 01/3

An analysis of flight measurements made near a wake vortex was conducted to explore the feasibility of providing a pilot with useful wake avoidance information. The measurements were made with relatively low cost flow and motion sensors on a light airplane flying near the wake vortex of a turboprop airplane weighing approximately 90000 lbs. Algorithms were developed which removed the response of the airplane to control inputs from the total airplane response and produced parameters which were due solely to the flow field of the vortex. These parameters were compared with values predicted by potential theory. The results indicated that the presence of the vortex could be detected by a combination of parameters derived from the simple sensors. However, the location and strength of the vortex cannot be determined without additional and more accurate sensors. Author

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

A92-10472

**KINEMATIC GPS FOR DIFFERENTIAL POSITIONING -
RESOLVING INTEGER AMBIGUITIES ON THE FLY**

PATRICK Y. C. HWANG (Rockwell International Corp., Cedar Rapids, IA) Navigation (ISSN 0028-1522), vol. 38, Spring 1991, p. 1-15. refs
Copyright

In kinematic GPS, the initial integer ambiguity must be resolved either by a static survey over time, or by instant calibration with a known baseline or an antenna exchange. While these standard methods require maintaining a baseline stationary to an earth-fixed reference frame during the initialization, there are situations when at least one of the receivers may be constantly in motion. This paper proposes two ideas for adapting standard kinematic techniques to situations that do not naturally allow for the constraint of a fixed baseline. The first calls for extracting the information needed to resolve the integer ambiguity from the very data collected while the kinematic survey is in progress. The second idea addresses the use of the antenna exchange technique for mobile platforms where the original locations of the antennas are not likely to remain stationary during the physical exchange. Both ideas count on information from additional measurements to augment their respective measurement models. Author

A92-10474

TRAVELING ON THE CURVED EARTH

ALLEN R. MILLER, IRA S. MOSKOWITZ (U.S. Navy, Naval Research Laboratory, Washington, DC), and JEFF SIMMEN (U.S. Naval Postgraduate School, Monterey, CA) Navigation (ISSN 0028-1522), vol. 38, Spring 1991, p. 71-78. refs
Copyright

By using the interpretation of rotations in three-dimensional space as certain 3×3 matrices (without even knowing explicitly any of the properties of these matrices), together with an elementary knowledge of vector analysis that includes the notion of dot product, an easy method is given for finding the equations of great circle paths (on spherical surfaces) as parameterized curves - first in terms of Cartesian coordinates, and then in terms of the more useful navigational coordinates of latitude and longitude. Author

A92-10475

ON THE OVERDETERMINED CELESTIAL FIX

THOMAS R. METCALF (Hawaii, University, Honolulu) and FREDERIC T. METCALF (California, University, Riverside) Navigation (ISSN 0028-1522), vol. 38, Spring 1991, p. 79-89. refs
Copyright

An algorithm for computing the best position fix (in the least-squares sense) from a sequence of observations of any number of celestial bodies is presented. This algorithm has several advantages, most notably that it does not rely on an initial guess of the position, is computationally expedient, and is simple enough to program on the more sophisticated hand-held calculators. The mathematical background for this algorithm, a description of its implementation, examples of its use on both simulated and real data, and an estimate of the error on the derived position are discussed. Author

A92-11876

MANAGING EUROPE'S AIR TRAFFIC SYSTEM

JOHN G. RICHARDSON (Computer Sciences Corp., El Segundo, CA) ICAO Journal (ISSN 0018-8778), vol. 46, Sept. 1991, p. 16-19.
Copyright

The design of an automated air traffic flow management (ATFM) system for Europe, which must balance the needs of all system users and the controller work force is discussed. Special attention is given to the recently developed traffic-demand analysis and planning system (TDAPS) which can support the European ATFM concept by providing automated flow management services to domestic and oceanic facilities. The activities of the TDAPS consist of continuous monitoring, analysis, solution, implementation, and maintenance of traffic flow; balancing demand and capacity; and solving serious excess-workload problems. I.S.

A92-11877

THE EUROPEAN ATC CHALLENGE

MICHEL JUBE (Thomson-CSF, Paris, France) ICAO Journal (ISSN 0018-8778), vol. 46, Sept. 1991, p. 20-22.
Copyright

The causes of the air traffic control (ATC) problems of Europe are discussed, which include, in some cases, congestion due to the lack of homogeneous radar coverage and, in other cases, an over-interrogation of aircraft due to the presence of too many secondary radars. A four-phase mode S radar development program which was initiated in 1984 in order to supply homogeneous radar coverage of Europe's airspace is described, along with a new-generation communications system for improved control and communications, which features a fully decentralized architecture and full ADA software. I.S.

N92-10020# Federal Aviation Administration, Atlantic City, NJ.

**SOLID-STATE RADAR BEACON DECODER (SSRBD)
OPERATIONAL TEST AND EVALUATION (OT/E)
INTEGRATION TEST PLAN**

THOMAS D. BRATTON Oct. 1991 41 p
(DOT/FAA/CT-TN91/30) Avail: NTIS HC/MF A03

The Solid State Radar Beacon Decoder (SSRBD) operational and integration tests are defined that will be conducted at the FAA operational facilities. These tests will be executed following the contractor site acceptance test. Each SSRBD test configuration will be addressed in conjunction with the associated interfaces which will be required to perform the testing in as near an operational environment as possible. The National Airspace System (NAS) requirements and test objectives can be traced to those designated in the SSRBD Master Test Plan (MTP). In addition to providing requirements traceability, this plan contains a description of the tests which will be executed, associated success criteria, roles and responsibilities of test personnel; and the overall flow of activities required for a successful test program. Author

N92-10996# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).

**A SYSTEMATIC FORMULATION, AS AN APPROACH TO AIR
TRAFFIC [DER LOESUNGSWEG FUEER DEN LUDVERKEHR
HEISST SYSTEMISCHER ANSATZ]**

H. FLECKENSTEIN 1991 27 p In GERMAN Presented at the Lufthansa DS-Symposium, Frankfurt, Fed. Republic of Germany, 6 Mar. 1991
(MBB-Z-0371-91-PUB; OTN-033124; ETN-91-90199) Avail: NTIS HC/MF A03

A proposal for a new Lufthansa air traffic information system is presented. It is shown that the global formulation system air traffic is to be considered as a system between airport, aircraft and flight safety subsystems. The basic pattern of the system takes into account the following determining functions which are to be optimized in an iterative process: project management, project planning, reliability/quality safety, configuration management, and system engineering. The functional streams of an air traffic system are defined. The position determination process is the key of general traffic control processes. The tasks of a safety/security management are defined. The execution of operative workshops is recommended. ESA

N92-10997# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.

THE ELECTRONIC AERONAUTICAL CHART FOR GENERAL AERONAUTICS: A SYSTEM SPECIFICATION [DIE ELEKTRONISCHE LUFTFAHRKARTE FUER DIE ALLGEMEINE LUFTFAHRT: EIN SYSTEMENTWURF]

MARIUS SCHLINGELHOF and DETLEF STOLZE 17 May 1991 54 p In GERMAN; ENGLISH summary (ILR-MITT-263(1991); ETN-91-90209) Avail: NTIS HC/MF A04

A new concept for a low cost navigational computer, which would provide new possibilities of increasing safety and reducing workload for pilots, is presented. An interface between computer and pilot can be provided by a moving map display making it unnecessary to trace flight paths with a finger on a paper map. A design of such a moving map display system is described. The aspects of software and hardware development, and the data acquisition problems are mentioned. ESA

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A92-10275

ADVANCED THERMOPLASTIC NOSE LANDING GEAR DOOR DEVELOPMENT

GARY G. CASSATT, ROBERT BROCK, JEFF KING, and DAVID BOONE (Boeing Co., Wichita, KS) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 2157-2173. refs Copyright

The application of advanced reinforced thermoplastic composite technology was successfully demonstrated through the design, fabrication, and test of a full-scale thermoplastic component for flight evaluation. The nose landing gear door of the V-22 Osprey aircraft was selected for this demonstration. IM7/PEEK unidirectional tape was used in a rapid, nonautoclave, thermoforming process which exhibited significant cost reduction over the thermoset honeycomb baseline design. The validation effort included, in addition to coupon and element tests, a structural test of the assembled door. The door has been successfully checked-fit into a V-22 aircraft and is planned to undergo service flight evaluations. Author

A92-10666

FLYING THE A340 IRON BIRD

HARRY HOPKINS Flight International (ISSN 0015-3710), vol. 140, Oct. 2, 1991, p. 24-26. Copyright

An overview is presented of the three A330/A340 simulation cabs, clustered near the 'iron bird' control rig and avionics test cells, which can be partially interconnected to them, principally by the use of optical fibers. Software production both for displays and for the new flight management guidance and envelope computer is accomplished on a CAD/CAM tool. A fourth simulator is used almost entirely for the preparation of control laws, also involving CAD/CAM. Attention is given to a simulated demonstration flight with a description of the handling characteristics observed. R.E.P.

A92-11012*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.

NASA TEST FLIGHTS WITH INCREASED FLIGHT STRESS INDICES

I. S. SMITH, JR. (NASA, Wallops Flight Center, Wallops Island, VA) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington,

DC, American Institute of Aeronautics and Astronautics, 1991, p. 65-71. refs

(AIAA PAPER 91-3665) Copyright

This paper presents the objectives, results, and conclusions stemming from a series of six test flights conducted for the National Aeronautics and Space Administration (NASA) by the National Scientific Balloon Facility (NSBF). Results from the test flights indicate that: (1) the current two U.S. balloon films are capable of being flown at significantly increased flight stress index values; (2) payload weights less than the design minimum payload can be reliably flown without fear of structural failure due to increased circumferential stress; and (3) large and rapid decreases in payload weight can be tolerated by current balloons without structural failure. Author

A92-11015*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.

STRUCTURAL BEHAVIOR OF SCIENTIFIC BALLOONS - FINITE ELEMENT SIMULATION AND VERIFICATION

WILLI W. SCHUR (NASA, Wallops Flight Center, Wallops Island, VA; New Mexico State University, Las Cruces) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 89-93. (AIAA PAPER 91-3668)

An off-the-shelf nonlinear finite element code was used to analyze fully inflated scientific balloons. The thin balloon film was modeled by shell bending elements. Numerical difficulties caused by insignificant bending stiffness terms were overcome by introducing some artificial bending stiffness. This approximation is justified by the fact that in thin shells with nonzero Gaussian curvature the membrane solution component is essentially independent of the bending solution component. Perturbation of the covered solution by increasing the bending stiffness by a full decade verified this assertion. This analytical approach was experimentally verified. As a result of this verification process it was discovered that the generally accepted linearly visco-elastic model for polyethylene film is inappropriate for a significant planar (as opposed to uniaxial) stress state. A linear elastic model presents a good approximation for planar stress states. Author

A92-11081

EXTENSIONS TO THE MINIMUM-STATE AEROELASTIC MODELING METHOD

MORDECHAY KARPEL (Technion - Israel Institute of Technology, Haifa) AIAA Journal (ISSN 0001-1452), vol. 29, Nov. 1991, p. 2007-2009. refs Copyright

The minimum-state (MS) aerodynamic approximation method, designed to minimize the number of aerodynamic states in the resulting aeroelastic model, and the physical weighting procedures are extended to augment their efficiency and generality and to improve the dynamic residualization. It is shown that MS aerodynamic approximations facilitate additional high-accuracy model size reduction via dynamic residualization. O.G.

A92-11123

APPLICATION OF SMART STRUCTURES TO AIRCRAFT HEALTH MONITORING

G. A. HICKMAN, J. J. GERARDI, and Y. FENG (Innovative Dynamics, Ithaca, NY) (Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990) Journal of Intelligent Material Systems and Structures (ISSN 1045-389X), vol. 2, July 1991, p. 411-430. refs Copyright

A prototype monitoring system designed to increase the safety of aging aircraft is discussed. In a series of experiments that demonstrate the system's feasibility in detecting structural damage as well as leading-edge ice accretion, 15 features were extracted from the sensor signals, and the best feature sets for classification were identified. Results are presented from laboratory, wind-tunnel, and flight tests showing the system's ability to accurately identify different types of signals corresponding to changes in the physical

parameters of the structure. Both active and passive sensing techniques were evaluated. Application of this technology for detecting structural defects during ground checks as well as warning of in-flight icing has the potential of extending the lifespan of aircraft. The cost of maintenance may be reduced through maintenance for cause based on actual environmental history rather than clock hours. P.D.

A92-11607#**TECHNOLOGY DEVELOPMENTS APPLIED TO THE AH-1W SUPERCOBRA**

CURTIS T. CREWS (U.S. Navy, Naval Air Systems Command, Washington, DC) and KAYDON A. STANZIONE (Praxis Technologies Corp., Woodbury, NJ) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Baltimore, MD, Sept. 23-25, 1991. 13 p. refs
(Contract N00019-90-C-0195)
(AIAA PAPER 91-3071)

Technological improvements to the AH-1W are described in terms of the expanded mission requirement proposed for the single-rotor attack helicopter. Specific attention is given to parameters of aircraft performance, mission equipment, weapons loadout, and doctrine. The specific developments addressed include those for rotor systems, transmission, a glass cockpit, alighting gear and an integrated crew station. Other improvements listed are enhancements for survivability, vulnerability, and aerodynamics. The increased mission requirements for the AH-1W can be met by incorporating the listed technological developments including a four-bladed rotor. The upgrades presented in the overview were investigated and found to significantly benefit the AH-1W with a four-bladed rotor system in terms of cost-effectiveness. C.C.S.

A92-11882**DORNIER DO.328 SPECIAL - EXAMINING THE HIGH-SPEED COMMUTER**

JULIAN MOXON, DOUGLAS BARRIE, and IAN GOOLD Flight International (ISSN 0015-3710), vol. 140, Oct. 9, 1991, p. 31-34, 36-40.
Copyright

A review is presented of the new Do.328 30-seat high-speed commuter aircraft that seeks to capture a significant portion of the market. Vital to its enhanced performance is the shape of the fuselage, wing-fuselage, and undercarriage fairings, and the high power provided by two PW119 turboprops with six-bladed propellers. The dual-acting propeller system uses a piston in the hub, capable of adjusting pitch to maintain constant engine rpm and also to feather the blade when necessary. Attention is given to the integrated cockpit system, structural cost and performance, and cabin design aims and configuration. R.E.P.

A92-12750**FIRST FLIGHT FOR AIRBUS A340**

JEFFREY M. LENOROVITZ Aviation Week and Space Technology (ISSN 0005-2175), vol. 135, Nov. 4, 1991, p. 36-38, 43, 46-48, 50, 51.
Copyright

First flight of Airbus A340 performed on October 25th, 1991 is described, and results of flight performance evaluation are discussed. The A340 is considered to be Western Europe's largest transport with a wingspan of 60.3 m, a maximum takeoff weight of 253500 kg, and a maximum fuel capacity of 135000 lit. The takeoff and initial phase of the test flight was performed with the fly-by-wire control systems operating in direct law which provides a direct relationship between the pilot inputs to the side-stick controller and the movement of the A340's control surfaces. The A340 maiden flight was completed without major system problems. O.G.

A92-13208* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

WIND-TUNNEL AND FLIGHT TESTS OF A DELTA-WING REMOTELY PILOTED VEHICLE

LONG P. YIP, DAVID J. FRATELLO, DAVID B. ROBELEN (NASA, Langley Research Center, Hampton, VA), and GEORGE M. MAKOWIEC (Vigyan Research Associates, Inc., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 728-734. Previously cited in issue 14, p. 2130, Accession no. A90-33891. refs
Copyright

A92-13246**WILL HYDRAULIC SYSTEMS MEET TOMORROW'S AIRCRAFT POWER REQUIREMENTS?**

JAMES H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 11, Nov. 1991, p. 9-13.
Copyright

While the hydraulic power requirements of military aircraft have continued to rise, so that those of the F-22 will require more than double the horsepower of the F-15, the space and weight allocated for hydraulic components have been substantially constrained. Studies have identified the most advantageous operating pressure for such systems to be 8000 psi; this leads to a 30-percent weight reduction and 40-percent volume reduction relative to a conventional 3000-psi system. The design of adequate stiffness into 8000-psi actuators has proven to be problematic; smaller piston areas reduce physical stiffness and in turn lower system resonant frequency. O.C.

N92-10022# Naval Postgraduate School, Monterey, CA.

CH-53E/AV-8B AIRCRAFT SLING LOAD RECOVERY SYSTEM ANALYSIS M.S. Thesis

ROSE M. ZAMMIT Sep. 1990 142 p
(AD-A239950) Avail: NTIS HC/MF A07 CSCL 01/2

This report reviews some of the problems encountered in the analysis of the CH-53E/AV-8B Aircraft Recovery System. Equations are developed for use in determining optimum sling lengths and AV-8B attachment point locations that will allow for damage free pickup, transport and set down of an AV-8B aircraft by a CH-53E helicopter. Based on the formulation, a computer program is written that may be used to determine various features of the recovery system, such as, attachment point locations, hook, pendant, sling and AV-8B attachment point loads. The program, with slight modification, may be used to analyze any helicopter/external sling load combination. Furthermore, the effects of rotor downwash on hook, pendant, sling and AV-8B attachment point loads was evaluated both in a hover and in forward flight. Results from an analysis of two different configurations at the range of CH-53E airspeeds and longitudinal center of gravity positions are presented. GRA

N92-10999*# Textron Bell Helicopter, Fort Worth, TX.

TECHNOLOGY NEEDS FOR HIGH SPEED ROTORCRAFT (3) Final Report

JACK DETORE and SCOTT CONWAY 10 Sep. 1991 109 p
(Contract NAS2-13072)
(NASA-CR-186433; NAS 1.26:186433; BHTI-699-099-329) Avail: NTIS HC/MF A06 CSCL 01/3

The objectives of this high speed rotorcraft technology evaluation are threefold: (1) to identify technologies needed to extend the cruise speed capability of rotorcraft; (2) to identify technology issues which must be resolved to obtain technical goals; and (3) to propose a technology plan that takes the technical disciplines to a state of readiness enabling applications with reasonably low risk. The spectrum of rotorcraft is examined with the intent of selecting two or more configurations for a more detailed analysis. The results of this investigation are presented.

Author

N92-11000*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ANALYSIS OF OPEN LOOP HIGHER HARMONIC CONTROL AT HIGH AIRSPEEDS ON A MODERN FOUR-BLADED ARTICULATED ROTOR

SESI KOTTAPALLI and JANE LEYLAND Aug. 1991 17 p

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

(NASA-TM-103876; A-91190; NAS 1.15:103876) Avail: NTIS HC/MF A03 CSDL 01/3

The effects of open loop higher harmonic control (HHC) on rotor hub loads, performance, and push rod loads of a Sikorsky S-76 helicopter rotor at high airspeeds (up to 200 knots) and moderate lift (10,000 lbs) were studied analytically. The analysis was performed as part of a wind tunnel pre-test prediction and preparation procedure, as well as to provide analytical results for post-test correlation efforts. The test associated with this study is to be concluded in the 40- by 80-Foot Wind Tunnel of the National Full-Scale Aerodynamics Complex (NFAC) at the NASA Ames Research Center. The results from this analytical study show that benefits from HHC can be achieved at high airspeeds. These results clear the way for conducting (with the requirement of safe pushrod loads) an open loop HHC test at high airspeeds in the 40- by 80-Foot Wind Tunnel using an S-76 rotor as the test article. Author

N92-11001# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanic's Panel.

ROTORCRAFT SYSTEM IDENTIFICATION

Sep. 1991 291 p

(AGARD-AR-280; ISBN-92-835-0632-4) Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

For fixed wing aircraft, system identification methods to determine stability and control derivatives from flight test data are used with confidence. The application of the same techniques to rotorcraft is not so far advanced mainly because of the helicopter aeromechanical complexity. Only a few specialists have concentrated on this field and the application in industry is still sporadic. To coordinate these activities within the AGARD nations, a working group was constituted to focus on the applicational aspects of the various individual approaches and to evaluate the strengths and weaknesses of the different methods. The findings are presented of the Working Group including a documentation of the data bases, the applied identification methodologies, and major application areas. For each of the three helicopters, comparisons of the obtained results are discussed in the format of case studies, covering data quality evaluations, identification, and the verification of the obtained models. Author

N92-11002# Naval Postgraduate School, Monterey, CA. **DEVELOPMENTAL FLIGHT TESTING OF A HALF SCALE UNMANNED AIR VEHICLE M.S. Thesis**

JAMES D. SALMONS Sep. 1990 61 p

(AD-A240347) Avail: NTIS HC/MF A04 CSDL 01/3

This thesis sought to perform developmental flight testing of a half-scale unmanned air vehicle. To do this the half scale version of the Pioneer (used by the U.S. Marine Corps for training) was chosen as the airframe to instrument because of problems that the Unmanned Air Vehicle Office at the Pacific Missile Test Center had identified in the full scale version of the Pioneer. Problems included: (1) discrepancies in the predicted and flight tested rate-of-climb, time-to-climb and fuel flow at altitude; (2) apparent autopilot related pitch instability; (3) tail boom structural failure; (4) severely limited lateral control; (5) slow pitch response causing degraded maneuverability at high gross weights; and (6) insufficient testing to determine the effects of the new wing on flight endurance. A developmental flight test was conducted for the purpose of predicting the longitudinal and lateral directional behavior of the full scale vehicle. Instrumentation, developed and installed in the radio controlled aircraft, allowed for measurement and recording of control surface movement, indicated airspeed, sideslip angle and angle of attack. The measurement system operated successfully; the data recording system suffered limitations due to vibration introduced into the airframe by the propeller and engine. Lateral directional data were obtained from steady sideslip maneuvers, but longitudinal data taken for trimmed flights with varied center-of-gravity positions were unusable. GRA

N92-11004# Army Aeromedical Research Lab., Fort Rucker, AL.

CONCEPT EVALUATION OF THE UH-60 EXTERNALLY MOUNTED RESCUE HOIST Final Report

JOSEPH R. LICINA, LARRY C. WOODRUM, and DOUGLAS P. PRITTS Jan. 1991 73 p

(Contract DA PROJ. 3M4-63807-D-836)

(AD-A240545) Avail: NTIS HC/MF A04 CSDL 01/3

The concept evaluation of an Externally Mounted Rescue Hoist (EMRH) was performed with the Breeze Eastern EMRH installed on a U.S. Army UH-60 helicopter. A comparative analysis was conducted between the EMRH and the Internally Mounted Rescue Hoist (IMRH) which assessed initial inspection, physical characteristics, installation, and compatibility with the aircraft, performance, and safety. The EMRH showed a significant improvement over the IMRH currently used in U.S. Army MEDEVAC aircraft. GRA

N92-11005# Naval War Coll., Newport, RI. Dept. of Operations.

THE ROLE OF STEALTH IN NAVAL AVIATION AND JOINT/COMBINED OPERATIONS Final Report

MARK P. GRISSOM 20 May 1991 27 p

(AD-A240595) Avail: NTIS HC/MF A03 CSDL 15/6

The low observable (stealth) technology holds great promise in increasing the effectiveness of naval aviation in support of the maritime strategy and joint/combined operations. Although at first it may seem that stealth is a panacea for nearly all tactical missions, its use needs scrutiny, particularly in strategic implications. This paper looks at stealth and its applicability in each of the four naval missions of power projection, presence, deterrence and sea control, as well as several supporting warfare areas such as anti-air warfare and anti-surface warfare. Lastly, the operational and strategic implications of its use in representative joint/combined operations is addressed. It is found that stealth reduces the risk of many power projection missions and needs less tactical support than conventional strike aircraft. The technology is not required in all missions, however, since the risk level of the mission may not justify the cost of stealth or the mission requires high power electromagnetic energy emissions which are counter to the reason for having stealth. Low observable aircraft can support joint operations such as the AirLand Battle Doctrine of the Army, although there are limitations. Combined operations are supported tactically for the same reasons naval warfare missions are but the risk of loss of allied aircraft and crews must be properly managed to avoid dissension among the haves and have nots of stealth technology. GRA

N92-11006# McDonnell-Douglas Corp., Saint Louis, MO. **NEW INSULATION CONSTRUCTIONS FOR AEROSPACE WIRING APPLICATIONS. VOLUME 1: TESTING AND EVALUATION Final Report, Feb. 1989 - Jan. 1991**

RON SOLOMAN, LYNN WOODFORD, and STEVE DOMALEWSKI Jun. 1991 853 p

(Contract F33615-89-C-5605)

(AD-A240638; WL-TR-91-4066-VOL-1) Avail: NTIS HC/MF A99 CSDL 09/1

This test program evaluated existing and new wire insulation constructions in a round wire configuration for aerospace applications. The goal of the program was to identify insulation candidates with balanced electrical, thermal, and mechanical properties. A comprehensive test program was developed to evaluate and statistically rank each wire construction. Testing was conducted using existing military and industry test methods. Forty-three tests were conducted on the wire samples evaluated. Initially, ten insulation candidates and two baseline constructions MIL-W-81381 and MIL-W-22759 (cross-linked ETEE) were evaluated using the 15 most important tests. The majority of candidates consisted of composite constructions of polyimide film and a fluoropolymer layer(s). Four of the best performing candidates and the baseline constructions were further evaluated for overall performance by evaluating properties such as abrasion and

cut-through resistance, chemical and fluid resistance, dry and wet arc tracking, and flammability and smoke generation. GRA

N92-11007# McDonnell-Douglas Corp., Saint Louis, MO.
NEW INSULATION CONSTRUCTIONS FOR AEROSPACE WIRING APPLICATIONS. VOLUME 2: THE 270 VDC ARC TRACKING TESTING WITH POWER CONTROLLERS Final Report, Feb. 1989 - Jan. 1991
 RON SOLOMAN, LYNN WOODFORD, and STEVE DOMALEWSKI Jun. 1991 218 p
 (Contract F33615-89-C-5605)
 (AD-A240639; WL-TR-91-4066-VOL-2) Avail: NTIS HC/MF A10 CSCL 09/1

The objective of Amendment 2 testing was to further evaluate the ability of insulations to inhibit arc propagation during short circuit conditions in 270 volt dc power distribution systems. Evaluations were performed using dry arc propagation tests on three inorganic insulations in unprotected harnesses and on four candidate and two baseline insulation constructions protected by power controllers. Six different power controllers were tested. Evaluations showed that the three unprotected inorganic insulations were not able to inhibit arc propagation in a 270 volt dc power distribution system. The three solid state power controllers demonstrated good to excellent performance in inhibiting arc propagation in 270 volt dc power distribution systems, and two of the three electromechanical controllers demonstrated moderate abilities. The third electromechanical controller was not able to inhibit arc propagation. The insulation constructions played no part in inhibiting arc propagation. GRA

N92-11008# Naval Postgraduate School, Monterey, CA.
DEVELOPMENT OF A 1/7TH SCALE FIGHTER UAV FOR FLIGHT RESEARCH M.S. Thesis
 DANIEL M. LEE Sep. 1990 82 p
 (AD-A240703) Avail: NTIS HC/MF A05 CSCL 01/3

A program was initiated to develop a radio-controlled fighter aircraft to be used for supermaneuverability and agility flight research. High angle-of-attack flight testing a high-risk and very expensive endeavor in manned aircraft, and wind tunnel testing to duplicate dynamic maneuvers is extremely difficult. Another means to conduct agility flight research in a low-cost, low-risk environment has been sought. Construction of a scaled generic Navy fighter model, to be powered by ducted-fan engines and controlled by radio command, was begun. Also, it was deemed essential to incorporate an emergency recovery system in the aircraft, should control be lost due to radio component failure, primary flight system malfunction, or departure from controlled flight. A parachute recovery system was designed, constructed, and tested for structural integrity, opening shock dampening, rapid deployment, and desired rate of descent. Work will continue, leading to flight testing of forebody modifications for enhanced control at high angles of attack. GRA

N92-11009# Office National d'Etudes et de Recherches Aérospatiales, Paris (France). Direction de l'Aérodynamique.
WING TIP TURBINE: ANALYSIS OF THE RESULTS OF S2MA SOUNDING OF MARGINAL VORTEX OF THE A320, TECHNICAL SUMMARY [TURBINE DE BOUT D'AILE: ANALYSE DES RESULTATS DES SONDAGES A S2MA DU TOURBILLON MARGINAL DE L'A320. RAPPORT TECHNIQUE DE SYNTHESE]
 F. MANIE Nov. 1990 34 p In FRENCH
 (Contract STPA-85-95-009)
 (ONERA-RTS-21/4365-AY-056A; ETN-91-90082) Avail: NTIS HC/MF A03

Tests (force, pressure, sounding) were carried out at the S2MA wind tunnel for flight conditions of A320 transonic crossing on the 4A.2 model at 1:16.5. The device has six degrees of freedom equipped with a pressure sensor of five holes. Six lower airfoils of free wing extremity were investigated to define the flow structure neighboring the marginal vortex. The results were analyzed to determine the entry conditions for defining the vanes and the

positioning of a wing tip turbine, a device intended to reduce the induced drag or to produce a power injection for transport aircraft. ESA

N92-11010*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MAXIMIZED GUST LOADS FOR A NONLINEAR AIRPLANE USING MATCHED FILTER THEORY AND CONSTRAINED OPTIMIZATION
 ROBERT C. SCOTT, ANTHONY S. POTOTZKY (Lockheed Engineering and Sciences Co., Hampton, VA.), and BOYD PERRY, III Sep. 1991 10 p Presented at the 1991 AIAA Atmospheric Flight Mechanics Conference, New Orleans, LA, 19-21 Aug. 1991 Previously announced in IAA as A91-47155
 (NASA-TM-104138; NAS 1.15:104138) Avail: NTIS HC/MF A02 CSCL 01/3

Two matched filter theory based schemes are described and illustrated for obtaining maximized and time correlated gust loads for a nonlinear aircraft. The first scheme is computationally fast because it uses a simple 1-D search procedure to obtain its answers. The second scheme is computationally slow because it uses a more complex multi-dimensional search procedure to obtain its answers, but it consistently provides slightly higher maximum loads than the first scheme. Both schemes are illustrated with numerical examples involving a nonlinear control system. Author

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

N92-10024*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A COMPENSATORY ALGORITHM FOR THE SLOW-DOWN EFFECT ON CONSTANT-TIME-SEPARATION APPROACHES
 TERENCE S. ABBOTT Washington Sep. 1991 19 p
 (NASA-TM-4285; L-16922; NAS 1.15:4285) Avail: NTIS HC/MF A03 CSCL 01/4

In seeking methods to improve airport capacity, the question arose as to whether an electronic display could provide information which would enable the pilot to be responsible for self-separation under instrument conditions to allow for the practical implementation of reduced separation, multiple glide path approaches. A time based, closed loop algorithm was developed and simulator validated for in-trail (one aircraft behind the other) approach and landing. The algorithm was designed to reduce the effects of approach speed reduction prior to landing for the trailing aircraft as well as the dispersion of the interarrival times. The operational task for the validation was an instrument approach to landing while following a single lead aircraft on the same approach path. The desired landing separation was 60 seconds for these approaches. An open loop algorithm, previously developed, was used as a basis for comparison. The results showed that relative to the open loop algorithm, the closed loop one could theoretically provide for a 6 pct. increase in runway throughput. Also, the use of the closed loop algorithm did not affect the path tracking performance and pilot comments indicated that the guidance from the closed loop algorithm would be acceptable from an operational standpoint. From these results, it is concluded that by using a time based, closed loop spacing algorithm, precise interarrival time intervals may be achievable with operationally acceptable pilot workload. Author

N92-11011# Air Force Environmental Technical Applications Center, Scott AFB, IL.
C-29A AIRCRAFT ALTIMETER ERRORS
 WILLIAM R. SCHAUB, JR. Jun. 1991 38 p
 (AD-A240486; USAFETAC/PR-91/011) Avail: NTIS HC/MF A03 CSCL 01/4

This report documents the results of a study initiated to solve problems with pressure altimeter errors (differences between indicated and true altitude) aboard Air Force C-29A flight inspection aircraft. A basic review of altimetry is provided, along with an explanation of how atmospheric changes affect barometric pressure and pressure altimeters. A method for in-flight correction of altimeter errors is provided, along with an appendix that gives monthly error statistics for the three C-29A working flight levels (1,000, 1,500, and 2,000 feet above ground level). Although the results of this study are applicable only to Scott Air Force Base, Illinois, they can be considered generally representative of other stations with similar field elevations in the midwestern United States. USAFETAC has the ability to produce climatological altimeter error data for any location from which representative upper-air and surface observations are available. GRA

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A92-10600**RENEWED INTEREST IN PULSED ENGINES MAY BE LINKED TO 'BLACK' AIRCRAFT**

WILLIAM B. SCOTT Aviation Week and Space Technology (ISSN 0005-2175), vol. 135, Oct. 28, 1991, p. 68, 69. Copyright

An overview is presented of recent advances in analytical methods that have stimulated research of unsteady combustion phenomena and revived interest in pulsed detonation engines (PDE). PDE powerplants utilize a shockwave created in a detonation, an explosion that propagates supersonically, to compress a fuel-oxidizer mixture prior to combustion, much as supersonic inlets which make use of internal and external shock waves for pressurization. Analyses using modern CFD tools have shown that PDE thrust levels can be controlled and varied over a broad range of Mach numbers. Attention is given to CFD simulations that indicate that properly configured PDEs might provide fuel-efficient propulsion for large vehicles in the Mach 0.2 to 3.0 flight regime. R.E.P.

A92-10955**AEROELASTIC STABILITY ANALYSIS OF AERIAL PROPELLERS**

SHENG ZHOU (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 6, Oct. 1991, p. 291-294. In Chinese. refs

Both the empirical method and numerical simulation are employed for predicting the onset of stall flutter. In the empirical method, three nondimensional parameters at a characteristic section of the propeller are used, i.e., reduced frequency, inlet relative Mach number and incidence parameter. The results of numerical simulation for a newly designed propeller are given. The variations of incidence and inlet relative Mach number at the characteristic section with aircraft flight velocity are shown graphically. The dependence of the aerodynamic damping of the propeller on the incidence at the characteristic section corresponds to the take-off regime of the airplane. It is shown that there is no danger of stall flutter onset in this case. The spanwise distribution of the incidence under the take-off regime is also given. The greatest possibility of aeroelastic instability of the propeller corresponds to the ground static state of the airplane. At the ground static regime the incidence of the characteristic section is 9.96 deg. But the results of the numerical simulation show that there is no onset of the stall flutter in this case. This conclusion has been testified by the long-term tests of the propeller. Author

A92-10956**EFFICIENT LIFTING LINE METHOD FOR COMPUTING PERFORMANCE OF PROPELLER**

ZEMIN CHEN and JIEYUAN PAN (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 6, Oct. 1991, p. 295-299. In Chinese. refs

An efficient lifting line method has been developed for computing the performance of a propeller. The present method features: (1) the local gradient on the mean camber surface is used as a boundary condition instead of a plane boundary condition so as to make the method applicable for propellers with large camber airfoil; (2) a very good approximation of the velocities induced by semiinfinite helical vortex lines is obtained by a combination of direct numerical integration of the exact integrand and exact analytical integration of its enveloped functions, so that the required computing time is reduced to only about 10 percent of the original one; (3) the effects of blade section drag and compressibility have been considered in the computation of the propeller performance. A comparison of analytical and experimental results for a propeller is presented. It demonstrates the validity of the computational results when the advance ratio is not too small. Author

A92-10957**AERODYNAMIC DESIGN OF PROPELLER BY NUMERICAL OPTIMIZATION**

JIEYUAN PAN and HUEDE QIAN (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 6, Oct. 1991, p. 300-304. In Chinese. refs

A numerical optimization method is presented for the aerodynamic design of a propeller. As the basis of optimization, the strip theory based on the Goldstein theory is applied to predict the propeller's aerodynamic performance. The comparison of the calculated results with experimental data shows that the strip theory is appropriate to the optimization. The mixed penalty function method is used for the optimization. By the means of the method presented here, two propellers have been designed and redesigned under identical flight conditions. The calculated results indicate that the variation of efficiency with geometry parameters is more gradual in the vicinity of the efficiency maximum. It is also shown that, if both chords and twists in different sections are taken as design variables, the blade of the optimized propeller would be narrower than that if only the twists are taken as design variables. Therefore the optimized propeller would be lighter and more efficient in cruise conditions. Author

A92-10961**AEROACOUSTICAL MODIFICATION OF A PROPELLER**

XIAODONG LI, XIAODONG YANG, and ZONGAN HU (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 6, Oct. 1991, p. 317-319. In Chinese. refs

An aeroacoustical modification of a propeller is considered with the aim of greatly enhancing its takeoff efficiency and reducing its noise level when its blade number, blade hub, and cruise efficiency are kept unchanged. A time-domain method is applied to predicting the near and far sound field. From iterative aeroacoustical and aerodynamical optimization, an optimum design scheme has been obtained. Two 1/3-scaled model propellers were made to simulate the original and modified propellers, respectively. The results of comparative ground experiments show that the overall sound pressure level decreases by 1 to 1.5 dB while other technical specifications are met. Author

A92-10962**EXPERIMENTAL CHARACTERISTICS COMPARISON BETWEEN TWO SCALE-MODEL PROPELLERS**

XICHANG MAO, JIEBING WANG, and HONGMIN LI (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 6, Oct. 1991, p. 320-324. In Chinese. refs

The aerodynamic and acoustic characteristics of two scale-model propellers are compared experimentally. A three-blade model (Model A) is a scale model of a production type. A four-blade model (Model B) is a scale model of a new designed propeller. Their rotational speeds vary between 1500 to 3000 rpm. Experimental results indicate that under identical operational conditions the four-blade propeller has a higher thrust coefficient but a lower noise level than the three-blade propeller and also has a lower noise level at the same power coefficient. The four-blade propeller, of course, is superior to the three-blade one in efficiency and overall performance. Author

A92-10968

A METHOD OF RELIABILITY ANALYSIS FOR PROPELLER BLADES

HUIMIN FU and ZHENTONG GAO (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 6, Oct. 1991, p. 345-348. In Chinese. refs

A distribution function of a 2D threshold is given for fatigue crack propagation. A 2D stress-threshold interference model is set up. The model is applicable to the reliability analysis and design of infinite life for propeller blades or other structural members with initial defects and accident damage. The functional correlation between the reliability of no crack growth and the initial crack sizes is obtained from the model, and the maximum permissible crack sizes can be determined, according to a given reliability level. In consideration of the fact that the longer the service time, the greater the probability of accident damage, the overhaul periods of propeller blades with high reliability are also given. Author

A92-10969

EFFECT OF ANTIICER ON PROPELLER PERFORMANCE

AIKUN ZHANG (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 6, Oct. 1991, p. 349-351. In Chinese.

Comparative experiments of a propeller with and without the antiicer have been completed in a wind tunnel. The analysis of the experimental data shows that the effect of the antiicer depends on the advance ratio (J) and the blade angle. The antiicer has no effect on the performance of the propeller when the blade angle is big enough and the advance ratio is small. The efficiency of the propeller with antiicer increases when the blade angle is big enough and the J is moderate or the blade angle is smaller and the J also small. The attached antiicer reduces efficiency at the big blade angle with a large advance ratio or at a smaller angle with a moderate ratio. When the aircraft takes off, the antiicer reduces propeller efficiency by 1.5 percent, and by 3 percent when the plane cruises. Author

A92-11282

COMPRESSOR COATING EFFECTS ON GAS TURBINE ENGINE PERFORMANCE

J. D. MACLEOD (National Research Council of Canada, Ottawa) and J. C. G. LAFLAMME (Canadian Forces Europe, CFB Baden-Soellingen, Federal Republic of Germany) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 113, Oct. 1991, p. 530-534. refs Copyright

The effect of an erosion- and corrosion-resistant compressor-blade coating on the performance of a new Allison T56 turboprop engine was investigated, using a specially designed test sequence to monitor small thermodynamic performance changes. Since the compressor must be completely disassembled to permit the application of the coating, the performance changes resulting from dismantling and reassembling the compressor were also evaluated. The results of the pre- and postcoating compressor tests showed that the most significant effects of the coating were on the corrected airflow, the compressor pressure ratio, and the combustor pressure ratio. I.S.

A92-12600

H2/AIR SUBSYSTEM COMBUSTION KINETICS IN AEROSPACEPLANE POWERPLANTS

AARON J. SABER (Concordia University, Montreal, Canada) and XIA CHEN IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 12 p. Research supported by NSERC. refs (IAF PAPER 91-276) Copyright

Gibbs free energy minimization is used to calculate equilibrium composition, and chemical kinetics is used to predict the species, temperature, and entropy profiles for subsonic and supersonic hydrogen/air combustion. For an initial temperature of 1073.15 K (800 C) and pressure of 1 atm, the equilibrium water mole fraction is only 0.279, about 20 percent below that for complete combustion; for flows at $M = 0.2$, the completion water mole fraction exceeds that for equilibrium combustion, but is less than that shown for single step complete reaction. Predicted Mach numbers for both subsonic flows and supersonic flows approach unity as reaction proceeds. As this occurs the reactions become thermodynamically choked and the calculations do not provide solutions. For all species, the structures are complex, but the data are presented in a suitable form for engineering analysis of aerospaceplane systems. Author

A92-12601

THERMODYNAMIC BEHAVIOUR OF HYDROGEN-POWERED HYPERSONIC RAMJETS FLYING ALONG IDEAL TRAJECTORIES

JOSEF REINKENHOF (DLR, Institut fuer Chemische Antriebe und Verfahrenstechnik, Hardthausen am Kocher, Federal Republic of Germany) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs (IAF PAPER 91-277) Copyright

A simulation model for the ramjet propulsion describing the strong coupling of thermodynamic and flightmechanic parameters is presented. The ideal trajectory is subdivided into segments each one representing the solution of a boundary value problem with additional constraints for dynamic pressure and minimum fuel consumption. The thermodynamic model of the ramjet comprises a precompression due to the angle of attack, a compression by a multiple shock system, a subsonic diabatic flow and an expansion in a Laval nozzle and along an unsymmetric expansion ramp. The thrust vectoring is realized by an alternating control of either geometries of the diffuser and the Laval nozzle or the angle of attack. Typical numerical results for the ramjet mode of a hydrogen-powered two-stage-to-orbit reference vehicle are discussed. Limiting values of the main parameters needed for design purposes of future ramjet propulsion systems and the test stands are given. Author

A92-13219

P&W F119 - VECTORED THRUST FOR THE F-22

STANLEY W. KANDEBO Aviation Week and Space Technology (ISSN 0005-2175), vol. 135, Nov. 18, 1991, p. 34, 35, 38. Copyright

An overview is presented of the plans to solidify the production configuration of the 35,000 lb thrust class F119 powerplant by mid-1992 to support the first run of a full-scale engineering and manufacturing development version of the engine by late 1992. Once the production configuration is stabilized, 33 flight-test engines will support 11 F-22 aircraft which are to begin flying in mid-1995. Attention is given to nozzle augmentor cooling and coating tests, the three-zone afterburner, the improved compressor aerodynamics, and the pitch-vectoring nozzle development. R.E.P.

N92-11012 University Coll. of North Wales, Bangor.

PARALLEL PROCESSING APPLICATIONS FOR GAS TURBINE ENGINE CONTROL Ph.D. Thesis

HAYDN ASHLEY THOMPSON 1990 275 p
Avail: Univ. Microfilms Order No. BRDX92129

The application of parallel processing to gas turbine control is described. A 3-spool high-bypass gas turbine engine and a

controller simulation are written in Occam and mapped onto transputer arrays. These simulations are further complicated with the addition of rehear. A comparison of the same simulations written in C is then performed using the Helios operating system for transputers and the Uniform system upon the Butterfly Plus Computer. These two systems use radically different approaches for interprocessor communication: the transputer using point-to-point serial links and the Butterfly using shared memory. The problems of applying formal methods to parallel asynchronous systems are addressed and the current design specifications are reviewed for their applicability to transputers. Using these specifications, three fault tolerant systems are implemented which address permanent, transient, persistent intermittent and Byzantine failures. A generalized solution to the problem of handling communication failures between the asynchronous transputers using a masking technique is also presented. The fault tolerant systems that are described use a variety of fault tolerant techniques and attempt to exploit the parallelism within the multiprocessor array for a reduction in execution time while simultaneously exploiting the inherent redundancy for fault tolerance. These implementations highlight the current limitations of present transputers and the advantages of the Occam language.

Dissert. Abstr.

N92-11014*# Maine Univ., Orono.
NUMERICAL SIMULATION OF THE REACTIVE FLOW IN ADVANCED (HSR) COMBUSTORS USING KIVA-2 Final Report,
1 Feb. 1990 - 31 Aug. 1991

NICHOLAS S. WINOWICH 1991 113 p

(Contract NAG3-1115)

(NASA-CR-188996; NAS 1.26:188996) Avail: NTIS HC/MF A06 CSDL 21/5

Recent work has been done with the goal of establishing ultralow emission aircraft gas turbine combustors. A significant portion of the effort is the development of three dimensional computational combustor models. The KIVA-II computer code which is based on the Implicit Continuous Eulerian Difference mesh Arbitrary Lagrangian Eulerian (ICED-ALE) numerical scheme is one of the codes selected by NASA to achieve these goals. This report involves a simulation of jet injection through slanted slots within the Rich burn/Quick quench/Lean burn (RQL) baseline experimental rig. The RQL combustor distinguishes three regions of combustion. This work specifically focuses on modeling the quick quench mixer region in which secondary injection air is introduced radially through 12 equally spaced slots around the mixer circumference. Steady state solutions are achieved with modifications to the KIVA-II program. Work currently underway will evaluate thermal mixing as a function of injection air velocity and angle of inclination of the slots.

Author

N92-11015# Cranfield Inst. of Tech., Bedford (England). Dept. of Turbomachinery and Engineering Mechanics.

RADIAL INFLOW TURBINE STUDY Interim Report No. 5, 21 Jan. - 30 Jun. 1991

S. HAMID and R. L. ELDER Jun. 1991 17 p

(Contract DAJA45-89-C-0006)

(AD-A240169; CIT-REF-06/769E(5); R/D-5824-AN-01) Avail: NTIS HC/MF A03 CSDL 21/5

The radial inflow turbine is a primary component used both in small gas turbines and turbochargers. Better understanding of the flow processes occurring within the small passages of the machine could well result in the improved design of units. As most of the detailed aerodynamics is still ill-defined, a joint research project with the objective of improving our understanding has been instigated by Cranfield, the U.S. Army and Turbomach (San Diego). This document describes the early attempts at obtaining measurements downstream of the rotor and provides some results.

GRA

N92-11016*# United Technologies Corp., East Hartford, CT.
STRUCTURAL TAILORING OF ADVANCED TURBOPROPS (STAT): USER'S MANUAL

K. W. BROWN Nov. 1991 124 p

(Contract NAS3-23941)

(NASA-CR-187101; NAS 1.26:187101; PWA-5967-43) Avail: NTIS HC/MF A06 CSDL 21/5

This user's manual describes the Structural Tailoring of Advanced Turboprops program. It contains instructions to prepare the input for optimization, blade geometry and analysis, geometry generation, and finite element program control. In addition, a sample input file is provided as well as a section describing special applications (i.e., non-standard input).

Author

N92-11017*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

REAL-TIME FAULT DIAGNOSIS FOR PROPULSION SYSTEMS

WALTER C. MERRILL, TEN-HUEI GUO, JOHN C. DELAAT, and AHMET DUYAR (Florida Atlantic Univ., Boca Raton.) 1991

8 p Presented at the International Federation of Automatic Control Symposium on Fault Detection, Supervision and Safety for Technical Processes-SAFEPROCESS 1991, Baden-Baden, Germany, 10-13 Sep. 1991

(NASA-TM-105303; E-6650; NAS 1.15:105303) Avail: NTIS HC/MF A02 CSDL 21/5

Current research toward real time fault diagnosis for propulsion systems at NASA-Lewis is described. The research is being applied to both air breathing and rocket propulsion systems. Topics include fault detection methods including neural networks, system modeling, and real time implementations.

Author

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A92-11122
STATIC AEROELASTIC CONTROL USING STRAIN ACTUATED ADAPTIVE STRUCTURES

KENNETH B. LAZARUS, EDWARD F. CRAWLEY (MIT, Cambridge, MA), and JONATHAN D. BOHLMANN (General Dynamics Corp., Advanced Methods Group, Fort Worth, TX) (Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990) Journal of Intelligent Material Systems and Structures (ISSN 1045-389X), vol. 2, July 1991, p. 386-410. refs

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The feasibility of using representative box wing adaptive structures for static aerolastic control is investigated. A deformable typical section is used to derive the optimal and suboptimal relations for induced strain actuated adaptive wings, and the relations developed are employed to design representative adaptive lifting surfaces which are assessed in trade studies. The optimal relations developed showed that optimal adaptive airfoil designs are possible for some realistic configurations, and effective suboptimal designs can be achieved for others. The important parameters associated with inducing curvature and twist, thereby altering the lifting forces on the airfoil, are determined. The potential benefits of using adaptive airfoils for aeroelastic control, rather than conventional articulated control surfaces, are demonstrated in trade studies. Greater control authority along with a lower weight penalty is found to be achievable using adaptive aeroelastic structures for a variety of wing designs.

P.D.

A92-11329
APPLICATION OF NONLINEAR CONTROL STRATEGIES TO AIRCRAFT AT HIGH ANGLE OF ATTACK

CHIEN Y. HUANG and GARETH J. KNOWLES (Grumman Corporate Research Center, Bethpage, NY) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 188-193. refs

Copyright

Nonlinear control strategies as applied to a high-alpha vehicle are discussed. The intent is to evaluate these methods for their benefit and advantage over conventional gain-scheduled linear controllers. Several techniques and their associated mechanisms are identified. The test aircraft used is the X-29, which is particularly suited for maneuvering at a high-alpha regime. A classical linear controller designed by Grumman and NASA is used for comparison. I.E.

A92-11361
DERIVATION OF AIRCRAFT LINEAR STATE EQUATIONS FROM IMPLICIT NONLINEAR EQUATIONS

B. L. STEVENS (Georgia Institute of Technology, Atlanta) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 465-469. Research supported by Georgia Institute of Technology. Copyright

The classical approach to deriving linear models of aircraft dynamics is cumbersome because of the lack of a formal algebraic framework. A new point of view is taken to provide a streamlined derivation for the linear state equations by using some formal mathematical tools. These tools include matrix calculus and implicit differential equations. The linear equations derived differ slightly from the conventional linear aircraft equations and are believed to be more accurate. They have been compared with linear equations derived by numerical linearization and found to agree to several decimal digits. I.E.

A92-11374
ON-LINE ADAPTIVE CONTROL OF UNSTABLE AIRCRAFT WING FLUTTER

R. P. PELOUBET, JR., R. L. HALLER, and R. M. BOLDING (General Dynamics Corp., Fort Worth, TX) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 643-651. refs (Contract F33615-84-C-3200) Copyright

The performance of an AFSS (adaptive flutter suppression system) was demonstrated on a flutter model in a wind tunnel. The AFSS used the CVA (canonical variate analysis) to identify stable and unstable plants under feedback control. The control laws were developed on-line using linear quadratic control design and the CVA identified plant. The AFSS was tested for changing wind tunnel conditions, different external store configurations, and a sudden change from a stable plant to an unstable plant by the release of an external store. I.E.

A92-11383* Rice Univ., Houston, TX.
OPTIMAL TRAJECTORIES AND GUIDANCE TRAJECTORIES FOR AIRCRAFT FLIGHT THROUGH WINDSHEARS

A. MIELE (Rice University, Houston, TX) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 737-746. Research supported by Boeing Commercial Airplanes, Air Line Pilots Association, and Texas Advanced Technology Program. refs (Contract NAG1-516) Copyright

The research on the optimization and guidance of flight trajectories in the presence of windshear performed by the Aero-Astronautics Group of Rice University is summarized. This research refers to windshear recovery systems and covers three areas of investigation: take-off, abort landing, and penetration landing. Determination of optimal trajectories and development of near-optimal guidance schemes are outlined. I.E.

A92-11384
AIRCRAFT CONTROL UNDER CONDITIONS OF WINDSHEAR
 GEORGE LEITMANN and SANDEEP PANDEY (California, University, Berkeley) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2.

New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 747-752. refs Copyright

The design of the control of an aircraft encountering windshear after takeoff is treated as a problem of stabilizing the climb rate about a desired value of the climb rate. The resulting controller is a feedback one utilizing only climb rate information. Its robustness vis-a-vis windshear structure and intensity is illustrated via simulations employing four different windshear models. The simulations were carried out for the Boeing 727 aircraft. I.E.

A92-11385* Minnesota Univ., Minneapolis.
AIRCRAFT CONTROL IN A DOWNBURST ON TAKEOFF AND LANDING

YIYUAN ZHAO (Minnesota, University, Minneapolis) and A. E. BRYSON (Stanford University, CA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 753-757. refs (Contract NAG2-191) Copyright

Aircraft takeoff and landing in the presence of downbursts are addressed. Dynamic optimization and feedback control system design techniques are used to determine proper guidance laws for aircraft in the presence of downbursts, and insensitivity to downburst structures is emphasized. Avoidance is the best policy. If an inadvertent encounter occurs when the aircraft is already close to or even in the downburst, the pilot should concentrate on vertical flight, unless he is sure which direction to turn for winds of less intensity. If such an encounter happens on takeoff, maximum thrust should be used aggressively and a lower climb rate or even descending flight is recommended. Similar strategy is applicable for abort landing. If an encounter happens on landing and encounter height is low, landing should proceed. It is recommended that the nominal horizontal and vertical velocities w.r.t the ground should be maintained, subject to a minimum airspeed constraint. A landing control logic is designed to accomplish this. I.E.

A92-11386
MANUALLY FLOWN WINDSHEAR RECOVERY TECHNIQUE

EDGARS A. KUPCIS (Boeing Commercial Airplane Group, Arlington, VA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 758, 759. Copyright

The windshear recovery technique described was developed following a thorough analysis of windshear related accidents and incidents. The recommended manually flown windshear recovery technique requires control of flight path by using maximum thrust and sufficient pitch attitude to establish a positive flight path or to minimize descent. This is done by pitching towards a target attitude of 15 degrees, using maximum rated thrust, and accepting lower than normal airspeeds during the recovery. The technique is relatively simple, easily recalled, generally applicable to all jet transports, and has been demonstrated to be effective in actual windshear encounters. The development and rationale for the recommended recovery technique are briefly outlined. I.E.

A92-11499
APPLICATION OF QUANTITATIVE FEEDBACK THEORY (QFT) TO FLIGHT CONTROL PROBLEMS

ISAAC HOROWITZ (California, University, Davis) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2593-2598. refs Copyright

QFT has been applied to numerous analog and digital flight control design problems. These include LTI fixed compensation m output, n input ($n =$ or greater than m) over a wide variety of flight conditions (FCs) with effector failures. Quantitative performance specifications are satisfied despite the failures, with

08 AIRCRAFT STABILITY AND CONTROL

no failure detection and identification. Rigorous nonlinear QFT design theory has been applied to large alpha problems for which LTI modeling is incorrect. QFT has been successfully applied to an X29 problem with varying numbers of right half plane poles and zeros (due to different FCs) close together. I.E.

A92-11500

ROBUST CONTROLLER DESIGN FOR AN ADVANCED FIGHTER AIRCRAFT

YUTAKA IKEDA, PAUL H. MCDOWELL, and ROWENA L. HARGIS (McDonnell Aircraft Co., Saint Louis, MO) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2600-2606. refs
Copyright

Two control law design methods are applied to a model of the longitudinal axis of an advanced fighter aircraft. One control law uses an $H(\infty)$ optimization technique with a mixed sensitivity objective function to perform multivariable loop shaping. The second control law uses numerical optimization techniques with an LQG objective function. A comparative evaluation of the two control laws is presented using time and frequency responses and structured singular value analysis. The results show that both control laws have satisfactory time domain performance and frequency responses. In addition, the two control law designs have comparable robust stability and performance characteristics. I.E.

A92-11501

ROBUST STABILIZATION OF A HELICOPTER MODEL

K. H. KIENITZ, Q.-H. WU, and M. MANSOUR (Zuerich, Eidgenossische Technische Hochschule, Zurich, Switzerland) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2607-2612. Research supported by Instituto Tecnológico de Aeronáutica. refs
Copyright

A case study in robust control is presented which assesses the availability of two robust stabilization methods for practical purposes. The methods considered accomplish $H(\infty)$ robust stabilization and quadratic stabilization, respectively. The system of concern is a helicopter-like laboratory model with two degrees of freedom. A comparison of the systems shows the superiority of the quadratically stabilizing controller. The main reason for this lies in the fact that uncertainty structure is considered in the Liapunov-based design. I.E.

A92-11502

U-PARAMETER DESIGN EXAMPLE - ROBUST FLIGHT CONTROL FOR WIND-SHEAR PROTECTION

CHUN-LIN SHEN, YANG WEI (Nanjing Aeronautical Institute, People's Republic of China), and PETER DORATO (New Mexico, University, Albuquerque) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2613-2615. Research supported by NNSFC. refs (Contract NSF INT-88-21843)
Copyright

U-parameter design theory is applied to the design of a fixed controller which simultaneously stabilizes a landing flight control system in wind-shear conditions (unstable dynamics) and non-wind-shear conditions (stable dynamics). Data from the Eastern Airlines flight 66 which crashed at Kennedy International Airport, June 25, 1975, are used. The resulting compensator requires only flight path angle measurements. The free strongly-bounded-real function which constitutes the U-parameter in this case is used to optimize, in a mean-squared sense, the no-wind-shear flight dynamics. An advantage of the U-parameter theory is that relatively simple controllers can be explored without loss of stability. I.E.

A92-11561

VSTOL AIRCRAFT FLIGHT CONTROL SYSTEM DESIGN USING $H(\infty)$ CONTROLLERS AND A SWITCHING STRATEGY

R. A. HYDE and K. GLOVER (Cambridge, University, England) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2975-2980. refs
Copyright

The problem of designing controllers for plants with widely varying dynamics over the required operating envelopes is addressed. The plant investigated is a generic VSTOL (vertical/short takeoff and landing) aircraft model (GVAM). The approach taken is to switch between linear controllers designed on linearizations of the nonlinear model. The linear designs make use of an open-loop singular value shaping technique which optimizes the system robustness to perturbations of the normalized coprime factors of the plant. Switching between controllers is achieved using a technique which enables smooth transition between controllers. It is concluded that the proposed loop-shaping approach has produced robust closed-loops, giving the necessary performance capability. I.E.

A92-11562

DESIGN OF THE FLARE CONTROL LAW FOR LONGITUDINAL AUTOPILOT USING $H(\infty)$ SYNTHESIS

ISAAC KAMINER and PRAMOD P. KHARGONEKAR (Michigan, University, Ann Arbor; Boeing Commercial Airplanes, Seattle, WA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2981-2986. refs
Copyright

The authors present the results of a design exercise in which the recent developments in $H(\infty)$ synthesis theory were applied to the problem of designing a flare mode for automatic landing for the longitudinal autopilot for a typical transport airplane. The controller must provide good touchdown performance in the presence of ground effects. The bulk of the engineering effort was in the formulation of an appropriate synthesis model. The linear design was suitably modified to satisfy some of the performance constraints. Results of linear analysis and simulation of the controller are presented. Its robustness characteristics are discussed. I.E.

A92-11563

ROBUST AUTOPILOT DESIGN FOR AIRCRAFT WITH MULTIPLE LATERAL-AXES CONTROLS USING $H(\infty)$ SYNTHESIS

ROBERT T. REICHERT (Johns Hopkins University, Laurel, MD) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2987-2992. refs
Copyright

The application of $H(\infty)$ control to the design of a lateral control system for an aircraft using conventional rudder and aileron controls as well as vertical canard control is considered. A linear time-invariant (LTI) model of the flight propulsion control coupling (FPCC) vehicle dynamics is chosen as an example. The design intent is to provide for decoupled response to pilot commands in yaw heading, lateral flight path, and aircraft roll attitude. Results indicate that the $H(\infty)$ synthesis technique provides a powerful tool for the design of LTI multichannel controllers. Problem-specific design goals and constraints are reflected as weighting functions applied to closed-loop transfer functions in the problem formulation (interconnection structure definition). It was shown that through the appropriate selection of closed-loop transfer functions (and weighting functions) it is possible to design for the following characteristics: steady-state command following accuracy, decoupled responses between command channels, closed-loop control bandwidth, restrictions on controller bandwidth, and tolerance to certain types of plant modeling uncertainty. The application of the approach to the FPCC aircraft yielded a design with robust performance and stability characteristics. I.E.

A92-11564

APPLYING MU-SYNTHESIS TO MISSILE AUTOPILOT DESIGN

PAUL JACKSON (Johns Hopkins University, Laurel, MD) IN:

IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2993-2998. refs
Copyright

Mu-synthesis combines the structured singular value and $H(\infty)$ control to design compensators for plants with structured uncertainty. The application of mu-synthesis to the design of a flight control system for a highly maneuverable, tail controlled missile is discussed. Performance goals are given in the time and frequency domains and include time constant, overshoot, stability margins, and high-frequency attenuation. The resulting control law desensitizes the system's performance to structured variations in the missile's aerodynamic properties and provides some robustness, in both a single- and a multi-loop sense, to variations and/or perturbations not included in the uncertainty model. I.E.

A92-11582

A TWO-FEEDBACK-LOOP ROBUST HELICOPTER CONTROLLER BASED ON EIGENSPACE TECHNIQUES AND $H(\infty)$ SYNTHESIS

P. APKARIAN, C. SAMBLANCAT, L. LE LETTY, and R. PATTON (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 3337-3339. refs
Copyright

The design of a robust helicopter control law is described. A two-loop structured feedback is proposed. The first loop is static and computed using eigenstructure assignment. Its objective is to provide decoupling between the different axes. The second loop is designed using $H(\infty)$ synthesis. The objective of the outer loop is to improve performance in terms of minimizing the error between the reference and output signals and robustness against additive perturbations due to plant uncertainties. This procedure allows the compensator order to be reduced with respect to more classically derived $H(\infty)$ solutions. I.E.

A92-11585

$H(\infty)$ ROBUST CONTROL SYNTHESIS FOR A FIGHTER PERFORMING A COORDINATED BANK TURN

PETER M. THOMPSON and RICHARD Y. CHIANG (Systems Technology, Inc., Hawthorne, CA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 3362-3366. refs
Copyright

$H(\infty)$ synthesis techniques are used to design a bank angle autopilot which commands a coordinated bank turn. Two variations of the $H(\infty)$ design are compared to a multivariable classical design. Both of the $H(\infty)$ designs have better performance and actuator robustness measures. The first $H(\infty)$ design, however, contains an undesirable cancellation of a lightly damped Dutch roll mode, which causes a poor parameter robustness measure. The second $H(\infty)$ design corrects this problem by using the same inner loop yaw damper as used by the classical design. I.E.

A92-11595

AN ASSESSMENT OF ROBUSTNESS OF VARIABLE STRUCTURE CONTROL SYSTEMS FOR ADVANCED AIRCRAFT MANOEUVRES

S. K. SPURGEON (Loughborough University of Technology, England) and R. J. PATTON (York, University, England) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 3588-3593. refs
Copyright

The authors use a model-following VSCS (variable structure control system) design approach to provide an aircraft control system which exhibits parameter insensitivity with good disturbance rejection while enabling the pilot to perform an advanced aircraft maneuver. Eigenstructure assignment is used to define a model

with these response characteristics. The authors also consider a definition and practical measures of the robustness of such a model-following VSCS. The VSCS technique is illustrated by considering the design of a lateral translational/yaw pointing control scheme for a conventional combat aircraft which has been augmented with a chin-fin to provide the required sideforce control. Analysis of the performance of this control scheme when subjected to a range of flight conditions is used to demonstrate application of the robustness criteria developed. I.E.

A92-13199

THE AERODYNAMIC INTERFERENCE BETWEEN A FLAPPED TANKER AIRCRAFT AND A RECEIVER AIRCRAFT DURING AIR-TO-AIR REFUELLING

A. W. BLOY, V. TROCHALIDIS, and M. G. WEST (Manchester, Victoria University, England) Aeronautical Journal (ISSN 0001-9240), vol. 95, Oct. 1991, p. 274-282. Research supported by Ministry of Defence of England and SERC. refs
Copyright

Wind-tunnel data are obtained from a model of a flapped tanker wing and receiver aircraft at varying vertical separation and the results compared with theory. In the model, the tanker wing is represented by a pair of horseshoe vortices from the wing and flap tips and an allowance is made for the self-induced vertical displacement of the trailing vortices at the receiver aircraft position. The aerodynamic loads on the receiver are determined by the vortex-lattice method and lifting-line theory, although an approximate method is used for the side force on the fin. Data were obtained from open and closed test sections in order to estimate the wind-tunnel boundary-interference effect. In the longitudinal case, significant differences were obtained between theory and experiment. Two reasons for the differences are the assumption that the trailing vortices are fully rolled up and the neglect of viscous decay of the vortices. The theoretical and experimental trends are similar although the theory overpredicts the rolling moment due to bank and sideways displacement while the corresponding side force and yawing moment are underpredicted. Author

N92-10028# National Aerospace Lab., Tokyo (Japan).

DEVELOPMENT OF DIGITAL/OPTICAL ROTARY POSITION TRANSDUCER

MITSUYOSHI MAYANAGI, MINORU TAKIZAWA, and TADAO UCHIDA May 1991 24 p In JAPANESE; ENGLISH summary (NAL-TR-1106; ISSN-0389-4010) Avail: NTIS HC/MF A03

Two different types of digital optical rotary position transducers were developed for use in future aircraft Fly-By-Light (FBL) control systems, i.e., one uses a collimated light on a code plate and the other a focussed light. These transducers can be used for sensing the pilot's control stick positions and/or control surface deflection in FBL control systems. The transducer system consists of two different transducers, four fiber cables, and an electronic interface unit having two light sources. This transducer system features the following: (1) resistance against electromagnetic interference and antilighning are obtained by an electrically passive transducer which uses no electronic parts; (2) connection between hardware is simplified by the use of serial digital optical signals obtained through optical pulses, optical fiber delay lines, an optical coupler, and the use of a time domain multiplexing concept; (3) system extendability is attained by using a time sharing processing system in which multiple optical encoders can be handled by a single processing circuit; and (4) optical power energy is reduced by utilizing optical pulses. These transducers cover a displacement of 360 deg. with a digital resolution of 12 bits (0.09 deg.).

Author

N92-11018# Honeywell, Inc., Minneapolis, MN. Systems and Research Center.

NEW METHODS IN ROBUST CONTROL Final Draft Technical Report, Mar. 1988 - Aug. 1991

JOHN DOYLE, BLAISE MORTON, and MIKE ELGERSMA 14 Aug. 1991 86 p

(Contract F49620-88-C-0077)

(AD-A240221; HSRC-C910684; AFOSR-91-0740TR) Avail: NTIS HC/MF A05 CSCL 01/4

This report describes advances in robust control in three areas: Optimal H infinity control, singular values, and dynamic inversion. The H infinity results are a thorough treatment of the theory as it has been developed over the last three years. The structured singular value section describes an application of the technique to represent inertia parametric variations in the Space Station. The dynamic inversion section addresses global stability of aircraft pitch axis dynamics using a dynamic inversion control approach. This document is the first draft of the final report for the program New Methods in Robust Control. The emphasis of this program was to develop mathematical theory to help control system designers faced with challenging control problems associated with advanced aerospace vehicles. Relevant applications include flight control systems for new Air force fighter/bomber aircraft, the F-18 HARV research vehicle, the NASP vehicle, the next generation launch system (ALS or NLS), and the Space Station. GRA

N92-11019# Naval Postgraduate School, Monterey, CA. **INITIAL DESIGN STUDY OF EXISTING FLIGHT CONTROL SYSTEM OF RPH AND FEASIBILITY STUDY OF IMPLEMENTING HHC ON THE SH-60B M.S. Thesis**

CHARLES D. WEBB Sep. 1990 52 p (AD-A240522) Avail: NTIS HC/MF A04 CSCL 01/4

The paper reports on two subjects, first the initial design study of a Remotely Piloted Helicopter's flight control system and secondly a feasibility study of implementing Higher Harmonic Control on the SH-60B aircraft. Described for the former is a complete study of stiffness constants, system freeplays and power requirements needed to provide Higher Harmonic Control to the Remotely Piloted Helicopter. The later gives practical design considerations for four alternate mechanical/hydraulic designs. The Remotely Piloted Helicopter Higher Harmonic Control work is an ongoing project at the Naval Postgraduate School and the SH-60B work is an initial study which is currently being evaluated at the Naval Air Test Center. GRA

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A92-11068

ADHESIVE SHEAR STRENGTH OF IMPACT ICE

M. C. CHU and R. J. SCAVUZZO (Akron, University, OH) AIAA Journal (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1921-1926. refs

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A quasistatic experimental technique was developed to determine the adhesive shear strength of impact ices formed inside an icing wind tunnel. Parametric studies were carried out to determine the dependence of the adhesive shear strength with various factors: (1) tunnel air temperature, (2) wind speed, (3) water drop size, (4) substrate material, (5) substrate surface roughness, and (6) substrate/impact ice interface temperature. The adhesive shear strength property was found to be statistical in nature, and on the average the mean varies between 17 and 60 psi for rime and glaze ice, respectively. The property is also found to be strongly dependent on substrate surface roughness and substrate/impact ice interface temperature above 25 F. There is a weak statistical linear correlation between wind speed and droplet size (momentum), but the shear strength appears to be independent of tunnel air temperature, accreted thickness, and substrate material used. Comparison is made with values obtained by other investigators, and differences are discussed. Author

A92-12194

PROSPECTS OF TURBULENCE RESEARCH BY MEANS OF TESTING BODIES IN MOTION

MICHIO OHJI, YASUO IKUSHIMA, and WEI-GUO WANG University of Electro-Communications, Bulletin (ISSN 0915-0935), vol. 3, Dec. 1990, p. 277-283. In Japanese. refs

Discussions are presented on the possibilities of measuring turbulent flows on reference frames fixed to moving bodies rather than on laboratory frames. In particular, compact units composed of electronic sensors, amplifiers, A/D converters, CPUs, power supplies and other accessories have been assembled and embedded inside test bodies to measure surface pressure distributions and instantaneous accelerations. This kind of flow measurement has been successfully applied to a sphere at free fall and a rotating cylinder in a wind tunnel, showing good prospects in future extension to wider classes of turbulence research.

Author

A92-12347

AUTOMATION OF THE MEASUREMENT PROCESS IN THE N2 WIND TUNNEL WITH THE SPITA N-3 SYSTEM

[AUTOMATYZACJA PROCESU POMIAROWEGO W TUNELU N-2 Z WYKORZYSTANIEM UKLADU SPITA N-3]

MALGORZATA ORLINSKA (Instytut Lotnictwa, Warsaw, Poland) Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 124-125, 1991, p. 72-86. In Polish. refs

The method of the SPIT A N-3 system application for measurement automation in the N2 wind tunnel is presented. A dedicated measurement-information system was produced. It was used to calibrate the ventilated, transonic measurement chamber of the N2 tunnel.

Author

A92-13201* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

TWO-DIMENSIONAL ADAPTIVE-WALL TESTS IN THE NASA AMES TWO- BY TWO-FOOT TRANSONIC WIND TUNNEL

EDWARD T. SCHAIRER, GEORGE LEE (NASA, Ames Research Center, Moffett Field, CA), and T. K. MCDEVITT (Complere, Inc., Palo Alto, CA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 673-682. Previously announced in STAR as N90-13407. refs

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The first tests conducted in the adaptive-wall test section of the Ames Research Center's 2- by 2-Foot Transonic Wind Tunnel are described. A procedure was demonstrated for reducing wall interference in transonic flow past a two-dimensional airfoil by actively controlling flow through the slotted walls of the test section. Flow through the walls was controlled by adjusting pressures in compartments of plenums above and below the test section. Wall interference was assessed by measuring (with a laser velocimeter) velocity distributions along a contour surrounding the model, and then checking those measurements for their compatibility with free-air far-field boundary conditions. Plenum pressures for minimum wall interference were determined from empirical influence coefficients. An NACA 0012 airfoil was tested at angles of attack of 0 and 2, and at Mach numbers between 0.70 and 0.85. In all cases the wall-setting procedure greatly reduced wall interference. Wall interference, however, was never completely eliminated, primarily because the effect of plenum pressure changes on the velocities along the contour could not be accurately predicted.

Author

A92-13214* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

WALL INTERFERENCE ASSESSMENT/CORRECTION FOR TRANSONIC AIRFOIL DATA

LAWRENCE L. GREEN and RAYMOND E. MINECK (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 774-780. Previously cited in issue 16, p. 2491, Accession no. A90-37945. refs

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N92-11020# Association Aeronautique et Astronautique de France, Paris.

APPLICATION OF INFRARED THERMOGRAPHY TO THERMAL FLUX MEASUREMENT IN WIND TUNNELS [APPLICATION DE LA THERMOGRAPHIE INFRAROUGE A LA MESURE DES FLUX THERMIQUES EN SOUFFLERIE]

D. BALAGEAS, D. BOSCHER, P. DELPECH, A. DEOM, J. FOURNIER, G. GARDETTE, C. LEMPEREUR, P. BERTHOUMIEUX, and J. M. MATHE (Centre d'Etudes et de Recherches, Toulouse, France) 1989 21 p In FRENCH Presented at the 26th Colloque d'Aerodynamique Appliquee, Toulouse, France, 23-25 Oct. 1990 Previously announced in IAA as A90-21051 Sponsored by Direction des Recherches, Etudes et Techniques; Service Technique des Programmes Aeronautiques; CEA; and Societe Matra (AAAF-NT-89-12; ISBN-2-7170-0945-0; ISSN-0243-0177; ETN-91-99953) Avail: NTIS HC/MF A03; CEDOCAR, Section des Diffusions, 26 Blvd Victor, 75996 Paris Armees, France, HC 15 francs

Different thermographic measuring methods are presented: passive thermography, in which the model is heated only by convection; stimulated thermography, in which a short radiative flux is superimposed. Practical examples of wind tunnel measurements are presented. A variety of technical problems to be resolved are addressed, related in particular to the three dimensionality of models, the control of their emissivity, to the presence of porthole windows, and to the quite limited spatial resolution of thermographic images obtained with current industrial imagers. ESA

N92-11021# Federal Aviation Administration, Atlantic City, NJ.
EVALUATION OF TWO HIGH-SPEED RUNWAY EXITS
RICK MARINELLI Sep. 1991 23 p
(DOT/FAA/CT-TN91/36) Avail: NTIS HC/MF A03

The effect of proposed changes in runway exit geometry and lighting on runway occupancy time was evaluated. Testing was conducted using a Boeing 727-200 simulator and a Boeing 727-100 aircraft. Subject pilots performed landings to runways equipped with the standard-design and the alternative-design exits. Exit speed was found to be affected most by pilot technique, with no advantage offered by the alternative design. Subjective evaluations by 12 pilots indicated a general preference for the standard-design exit. Author

N92-11022*# National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.
MODEL REPRESENTATION IN THE PANCOR WALL INTERFERENCE ASSESSMENT CODE
JASSIM A. AL-SAADY Aug. 1991 26 p
(NASA-TM-104152; NAS 1.15:104152) Avail: NTIS HC/MF A03 CSCL 14/2

An investigation into the aircraft model description requirements of a wall interference assessment and correction code known as PANCOR was conducted. The accuracy necessary in specifying various elements of the model description were defined. It was found that the specified lift coefficient is the most important model parameter in the wind tunnel simulation. An accurate specification of the model volume was also found to be important. Also developed was a partially automated technique for generating wing lift distributions that are required as input to PANCOR. An existing three dimensional transonic small disturbance code was modified to provide the necessary information. A group of auxiliary computer programs and procedures was developed to help generate the required input for PANCOR. Author

N92-11023*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
FURTHER DEVELOPMENTS RELATING TO THE NASA LANGLEY RESEARCH CENTER 13-INCH MAGNETIC SUSPENSION AND BALANCE SYSTEM Final Report, period ending 31 Jul. 1991
COLIN P. BRITCHER Nov. 1991 28 p

(Contract NAG1-1142)

(NASA-CR-188995; NAS 1.26:188995) Avail: NTIS HC/MF A03 CSCL 14/2

A few specific developments that were undertaken recently to the magnetic suspension and balance system (MSBS) are detailed. The improvements are as follows: modifications to the digital control system to accommodate a modified position sensing system; development of pressure telemetry systems; and revisions to the wind tunnel test section. Author

N92-11024*# Naval Postgraduate School, Monterey, CA.
PARAMETER IDENTIFICATION STUDIES ON THE NASA/AMES RESEARCH CENTER ADVANCED CONCEPTS FLIGHT SIMULATOR M.S. Thesis

THOMAS P. MCKAVITT, JR. Sep. 1990 73 p Sponsored by NASA. Ames Research Center
(NASA-TM-105126; NAS 1.15:105126; AD-A240587) Avail: NTIS HC/MF A04 CSCL 14/2

The results of an aircraft parameters identification study conducted on the National Aeronautics and Space Administration/Ames Research Center Advanced Concepts Flight Simulator (ACFS) in conjunction with the Navy-NASA Joint Institute of Aeronautics are given. The ACFS is a commercial airline simulator with a design based on future technology. The simulator is used as a laboratory for human factors research and engineering as applied to the commercial airline industry. Parametric areas examined were engine pressure ratio (EPR), optimum long range cruise Mach number, flap reference speed, and critical take-off speeds. Results were compared with corresponding parameters of the Boeing 757 and 767 aircraft. This comparison identified two areas where improvements can be made: (1) low maximum lift coefficients (on the order of 20-25 percent less than those of a 757); and (2) low optimum cruise Mach numbers. Recommendations were made to those anticipated with the application of future technologies. GRA

N92-11025# Naval Postgraduate School, Monterey, CA.
CALIBRATION OF THE NAVAL POSTGRADUATE SCHOOL 3.5' X 5.0' ACADEMIC WIND TUNNEL M.S. Thesis
DUANE E. NESTOR Sep. 1990 83 p
(AD-A240614) Avail: NTIS HC/MF A05 CSCL 14/2

The purpose of this thesis was to revitalize the Naval Postgraduate School's 3.5' x 5.0' academic wind tunnel. The wind tunnel had sustained previous damage to one of two sets of counter-rotating blades. Because of this change in configuration, a wind tunnel calibration was deemed necessary. Along with the calibration a digital data acquisition system was designed and implemented to aid in the data collection, storage and analysis for this project and future projects, using this wind tunnel. The test section airspeed calibration data contained a substantial amount of scatter indicating flow straighteners may be required. The wind tunnel turbulence intensity was found to be relatively low considering the configuration change and is expected to reach an acceptable level (less than 0.3 percent) with the planned installation of turbulence screens in the settling chamber. GRA

N92-11028# Federal Aviation Administration, Atlantic City, NJ.
PROTOTYPE RUNWAY HOLD-SHORT LIGHTING SYSTEM
ERIC S. KATZ and THOMAS H. PAPROCKI (MiTech, Inc., Washington, DC.) Sep. 1991 16 p
(DOT/FAA/CT-TN91/43) Avail: NTIS HC/MF A03

A prototype runway hold-short lighting system was developed at the FAA Technical Center. The purpose of this lighting system is to provide identification to a pilot, while landing during intersecting runway landing and takeoff operations, of the point at which he must hold short when so instructed by Air Traffic Control. During an in-service evaluation at Boston Logan Airport, user airline pilots were asked to comment on the effectiveness of the hold-short lighting system. Results of the evaluation indicate that the hold-short lighting system provides a landing pilot with a positive indication of the point at which he must hold short during the rollout after landing. Author

N92-11029# Federal Aviation Administration, Atlantic City, NJ.
SURFACE PAINTED TAXIWAY MARKINGS AT SEATTLE-TACOMA INTERNATIONAL AIRPORT
 KEITH W. BAGOT and THOMAS H. PAPROCKI (MiTech, Inc., Washington, DC.) Oct. 1991 20 p
 (DOT/FAA/CT-TN91/49) Avail: NTIS HC/MF A03

A prototype system of surface painted taxiway markings was evaluated at Seattle-Tacoma International Airport (SEATAC). The purpose of this evaluation was to determine the usefulness, from the pilot's and controller's viewpoint, of the surface painted markings to provide controllers with location of queued aircraft under conditions of low visibility. User pilots from Alaska Airlines as well as user controllers from SEATAC Tower were asked to comment on the effectiveness of the markings. Results of the evaluation indicate this system of painted taxiway surface markings does not provide the aircraft location information essential for supporting low visibility (400-ft runway visual range) taxi operations. Author

N92-11030*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MAGNETIC SUSPENSION AND BALANCE SYSTEMS: A COMPREHENSIVE, ANNOTATED BIBLIOGRAPHY
 MARIE H. TUTTLE, DEBORAH L. MOORE (Vigyan Research Associates, Inc., Hampton, VA.), and ROBERT A. KILGORE Washington Aug. 1991 68 p. Supersedes NASA-TM-80225 and NASA-TM-84661
 (NASA-TM-4318; L-16974; NAS 1.15:4318; NASA-TM-80225; NASA-TM-84661) Avail: NTIS HC/MF A04 CSCL 14/2

This bibliography contains 301 entries. Results are reported of recent studies aimed at increasing the research capabilities of magnetic suspension and balance systems; e.g., increasing force and torque capability, increasing angle of attack capability, and increasing overall system reliability. The problem is addressed of scaling from the relatively small size of existing systems to much larger sizes. The purpose of the bibliography is to provide an up-to-date list of publications that might be helpful to persons interested in magnetic suspension and balance systems for use in wind tunnels. The arrangement is generally chronological by date of presentation. However, papers presented at conferences or meetings are placed under dates of presentation. The numbers assigned to many of the citations have been changed from those used in the previous bibliography. This has been done in order to allow outdated citations to be removed and some recently discovered older works to be included in their proper chronological order. Author, source, and subject indexes are included in order to increase the usefulness of this compilation. Author

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ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

A92-11345
REAL PARAMETER UNCERTAINTY AND PHASE INFORMATION IN THE ROBUST CONTROL OF FLEXIBLE STRUCTURES

D. S. BERNSTEIN, E. G. COLLINS, JR., and D. C. HYLAND (Harris Corp., Melbourne, FL) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 379, 380. refs
 (Contract F49620-89-C-0011; F49620-89-C-0029)

Copyright

Real parameter uncertainty and phase information play a key

role in the analysis and synthesis of robust controllers for lightly damped flexible structures. The purpose of this study is to examine the impact of these issues on structural control, their interrelationship, and their manifestation within the analysis and synthesis of feedback systems. The discussion is illustrated by examining robust controllers designed for the ACES structure at Marshall Space Flight Center. These controllers were designed by means of the maximum entropy generalized LQG (linear quadratic Gaussian) methodology. I.E.

A92-12570
SAENGER AND THE GERMAN HYPERSONICS TECHNOLOGY PROGRAMME - STATUS REPORT 1991

HERIBERT KUCZERA, PETER SACHER (MBB GmbH, Munich, Federal Republic of Germany), and PAUL KRAMMER (MTU Motoren- und Turbinen-Union Muenchen GmbH, Munich, Federal Republic of Germany) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 14 p. refs
 (IAF PAPER 91-198) Copyright

The present status of Saenger, the reference concept for the German Hypersonics Technology Program, is described. Alternatives for a flight test vehicle, the status of technological activities in the area of air-breathing propulsion as well as aerothermodynamics and propulsion integration, materials, and structures are examined. Programmatic considerations are addressed. C.D.

A92-12599
ADVANCED SCRAM-LACE SYSTEM CONCEPT FOR SINGLE-STAGE-TO-ORBIT SPACE PLANE

Y. MIKI, M. TOGAWA, T. TOKUNAGA (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan), K. EGUCHI, and T. YAMANAKA (National Aerospace Laboratory, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p. refs
 (IAF PAPER 91-272) Copyright

The paper describes a conceptual design of a propulsion system for a 350 MG spacecraft, which is considered a most promising propulsion system for realizing a lightweight reusable SSTO vehicle. The system consists of a scramjet engine with thermal energy recovery from the aerodynamically-heated vehicle and a tank-return cycle liquefied-air-cycle engine (LACE) with an air compressor. A schematic diagram illustrating SCRAM-LACE propulsion is included along with data illustrating the performance of LACE and scram propulsion cycles. I.S.

A92-12742*# Maryland Univ., College Park.
APPLICATION OF WAVERIDER-BASED CONFIGURATIONS TO HYPERSONIC VEHICLE DESIGN

MARK J. LEWIS (Maryland, University, College Park) AIAA, Applied Aerodynamics Conference, 9th, Baltimore, MD, Sept. 23-25, 1991. 10 p. Research supported by NASA. refs
 (AIAA PAPER 91-3304) Copyright

The hypersonic waverider concept is explored in the context of aircraft design and optimization. Waveriders are vehicles which provide the highest known values of lift-to-drag ratio, suggesting that they are ideal for hypersonic cruise applications. However, these high lift-to-drag ratios are not retained with engine integration. It is shown that waveriders may have applications to the design of accelerating vehicles, even though high L/D is no longer a priority, because they exhibit relatively low drag, and have highly desirable properties for engine/airframe integration. Along these lines, waveriders provide highly uniform flowfields, making them ideal for forebodies on engine-airframe integrated configurations. The inverse design methodology of a waverider lends itself readily to the vehicle design process. Characteristics which govern the performance of a hypersonic vehicle for cruise and accelerating flight are examined, and applied to waverider vehicle design. Finally, it is shown that waveriders, though configured for the specific shock flowfield of a single design point, have acceptable off-design performance characteristics. Author

A92-13227

LANDING SPACECRAFT GENTLY ON EARTH - THE SOVIET PARACHUTE SYSTEMS

D. HAESELER British Interplanetary Society, Journal (ISSN 0007-094X), vol. 44, Nov. 1991, p. 534-536. refs

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Four different Soviet parachute systems for landing spacecraft gently on earth are described. These include a parachute system for manned descent capsules, intended to bring the vertical velocity of a descent capsule weighing up to 3100 kg down to 8-10 m/sec; a system for descent of earth-orbiting satellites, to land descent capsules weighing up to 3000 kg down to 7.5-8.5 m/sec vertical velocity; a system for descent of used rocket stages, to bring down used booster stages of 5 to 70 ton mass; and a drogue parachute system for reusable space shuttle orbiters, used to slow down the speed of a space shuttle orbiter after touchdown on a runway. I.S.

A92-13247

NASP - EXPANDING SPACE LAUNCH OPPORTUNITIES

Aerospace Engineering (ISSN 0736-2536), vol. 11, Nov. 1991, p. 15-17.

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NASP is envisioned as an airbreathing-propulsion vehicle in order to circumvent the weight and volume constraints imposed by conventional rockets' carriage of the fuel's oxidizer; this is typically 8 lbs/lb of fuel. Because it offers a potential vehicle weight reduction of 20 percent, slush H₂ fuel has been the focus of propulsion system studies. Attention is presently given to the framework defining the design features and technology readiness imperatives for both the X-30 NASP technology demonstrator and prospective NASP-derived vehicles (NDVs). The primary driver of NDV development is an assured-launch capability for military payloads. O.C.

N92-10053*# Stuttgart Univ. (Germany, F.R.). Inst. for Space Systems.

IRS ORGANIGRAM

ERNST MESSERSCHMID In NASA. Lewis Research Center, Magnetoplasma Dynamic Thruster Workshop 19 p 1991

Avail: NTIS HC/MF A09 CSDL 21/8

Charts and graphs relative to magnetoplasma dynamic (MPD) thruster technology are given. The research activities at the Institute of Space Transportation, University of Stuttgart, are summarized. Information is given on the Institute's Electric Propulsion and Plasma Wind Tunnel; thermal arcjet research; the nozzle-type thruster, DT-IRS; nozzle-type MPD thrusters; a hot anode thruster; the DT6 thruster; the ZT-1 thruster; the cylindrical MPD thruster; and a comparison of continuous and quasi-steady MPD. Author

N92-10062# Colorado Univ., Boulder. Dept. of Mechanical Engineering.

CONTRACTORS MEETING IN PROPULSION

M. A. BIRKAN and J. M. TISHKOFF 2 Aug. 1991 283 p Meeting held in Boulder, CO, 10-14 Jun. 1991

(Contract AF-AFOSR-0541-89; AF PROJ. 2308)

(AD-A240057; AFOSR-91-0713TR) Avail: NTIS HC/MF A13

CSDL 21/2

Abstracts are given for research in airbreathing combustion, rocket propulsion, and diagnostics in reacting media supported by the Air Force Office of Scientific Research. Major topics include: Gas turbines, Shear layer, Lasers, Fluorescence, Spectroscopy, Rocket, Engines, and Scramjets. GRA

N92-11070*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.

PREDICTION OF FORCES AND MOMENTS FOR HYPERSONIC FLIGHT VEHICLE CONTROL EFFECTORS Semiannual Report

MARK D. MAUGHMER, LYLE N. LONG, and PETER J. PAGANO 1991 48 p

(Contract NAG1-849)

(NASA-CR-188954; NAS 1.26:188954) Avail: NTIS HC/MF A03

CSDL 22/2

Developing methods of predicting flight control forces and moments for hypersonic vehicles, included a preliminary assessment of subsonic/supersonic panel methods and hypersonic local flow inclination methods for such predictions. While these findings clearly indicate the usefulness of such methods for conceptual design activities, deficiencies exist in some areas. Thus, a second phase of research was proposed in which a better understanding is sought for the reasons of the successes and failures of the methods considered, particularly for the cases at hypersonic Mach numbers. To obtain this additional understanding, a more careful study of the results obtained relative to the methods used was undertaken. In addition, where appropriate and necessary, a more complete modeling of the flow was performed using well proven methods of computational fluid dynamics. As a result, assessments will be made which are more quantitative than those of phase 1 regarding the uncertainty involved in the prediction of the aerodynamic derivatives. In addition, with improved understanding, it is anticipated that improvements resulting in better accuracy will be made to the simple force and moment prediction. Author

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CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A92-10213

BMI/BIS (ALLYLPHENOXYPHTHALIMIDE)-COPOLYMERS - A NEW FAMILY OF RESINS FOR ADVANCED COMPOSITES WITH IMPROVED THERMAL OXIDATIVE STABILITY

H. D. STENZENBERGER, P. KOENIG, W. ROEMER, M. HERZOG (Technochemie GmbH, Dossenheim, Federal Republic of Germany), and W. V. BREITIGAM (Shell Development Co., Houston, TX) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1232-1243. refs

Copyright

A new family of high-temperature-resistant copolymers is introduced. Attention is given to the following aspects of the new materials: the chemistry and properties of BMI/bis (allylphenoxyphthalimide), the thermal oxidative stability of state-of-the-art bis-maleimide resins in comparison to the new BMI/bis (allylphenoxyphthalimide) system, and the thermal oxidative stability of carbon-fiber laminates made with selected BMI resins. The new bismaleimide resin system comprised of Compimide 796 and bis (2-allylphenoxyphthalimide) toluene is found to be a candidate for long-term application around 250 C. From aging data it is concluded that free hydroxyl groups as in 6F-DABA cause reduced thermal oxidative stability. Other diallylbisphenols show similar results. C.A.B.

A92-10232

AEROSPACE ARALL - A CHALLENGE FOR THE AIRCRAFT DESIGNER

JAN W. GUNNINK (Akzo, Fibers and Polymers Div., Arnhem, Netherlands) and BOUD VOGELANG (Delft University of Technology, Netherlands) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1509-1522. refs

Copyright

The application of Aerospace Arall will solve a lot of problems in designing primary as well as secondary structures. This material offers weight savings of more than 30 percent. Originally developed as a fatigue-insensitive material, it turns out that dedicated grades of Aerospace Arall have very high static as well as residual strength

and extremely good impact properties. The designer can now tailor materials to their applications. This aspect will be much simpler for Aerospace Arall with its dedicated lay-up and thickness. The allowables and requirements the aircraft designer has to deal with and which impact they have on the application of Aerospace Arall are discussed. Some current aircraft structural designs and applications are examined. Author

A92-10238**THERMAL PROPERTIES OF HIGH PERFORMANCE THERMOPLASTIC COMPOSITES BASED ON POLY(ETHER KETONE KETONE) (PEKK)**

IKE Y. CHANG and BENJAMIN S. HSIAO (Du Pont de Nemours Fibers and Composites Development Center, Wilmington, DE) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1587-1601. refs

Copyright

Recent progress in the characterization of the thermal properties of the PEKK matrix and its composites such as crystallinity, melt rheometry, pressure-volume-temperature relations, thermal expansion, thermal conductivity, and heat capacity are reviewed. Crystallization kinetic measurements showed that the PEKK matrix and AS-4/PEKK composites have a fast crystallization rate and may crystallize in a wide range of cooling rates during the thermoforming process. The optimum isothermal crystallization temperature for the PEKK-based composites is established at 255 C with a minimum peak-time of 8 sec. No significant difference in isothermal crystallization kinetics was found between PEKK neat resin and AS-4/PEKK composites. In DSC analysis, PEKK exhibited double-melting transition behavior after isothermal annealing or slow cooling, which is attributed to the melting of two crystalline regions. PEKK was found to have a higher T_g, a lower equilibrium melting temperature, and a lower melt viscosity than PEEK.

C.A.B.

A92-10271**NEW THERMOPLASTIC COMPOSITES FOR AIRCRAFT STRUCTURES AND INTERIORS**

DANIEL LEESER and BRAD BANISTER (ICI Composites, Inc., Tempe, AZ) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 2103-2110.

Copyright

The use of amorphous thermoplastic polymers as a composite matrix is evaluated. Amorphous thermoplastic reinforced polymer composites can be consolidated at temperatures 100 to 200 F below temperatures needed to consolidate semicrystalline materials with the same service temperature. The employment of amorphous thermoplastic polymers as matrices in composite materials is shown to broaden the spectrum of materials available to the composite designer. Versatile impregnation routes allow a wide range of polymers and blends to be impregnated into a large number of product forms. The ability to reduce the prepreg residual solvent to negligible amounts permits rapid processing techniques to be performed safely. Amorphous thermoplastic composites are shown to have excellent mechanical properties and outstanding fire resistance.

P.D.

A92-11812**PROCESSING PARAMETERS FOR CARBON/PMR-15 COMPOSITE FLAT PANELS**

PAUL HONKA (McDonnell Douglas Corp., Saint Louis, MO) SAMPE Quarterly (ISSN 0036-0821), vol. 23, Oct. 1991, p. 58-64. Copyright

A study was performed in the Missile Airframe Technology Group of the McDonnell Douglas Missile Systems Company to determine processing parameters for the fabrication of carbon/PMR-15 composite flat panels. Development began with the identification of bagging procedures required for autoclave processing of this material. After establishing processing

parameters for carbon/PMR-15, this technology could then be applied to filament winding airframes for supersonic aircraft. A flat laminate has been successfully autoclave-cured with a 1.7 volume percent void content using this approach. This new technique eliminates both the perforated caul plates and the bleeder pack, and uses a nonporous top sheet to block vertical resin flow.

Author

A92-11993**FRACTURE BEHAVIOUR OF HIGH-TEMPERATURE POLYMER COMPOSITES**

Z. QIAN, D. MITRAMAJUMDAR, and H. AGLAN (Tuskegee University, AL) Journal of Materials Science Letters (ISSN 0261-8028), vol. 10, Oct. 15, 1991, p. 1208-1210. Research supported by Argo-Tech Corp. refs

Copyright

The present study of high-temperature polymer fracture behavior, as well as the relative validity of linear-elastic fracture mechanics (LEFM), gives attention to the fracture of carbon fabric-reinforced PMR-II-20 polyimide matrix composite. A complex fracture behavior is observed involving a combination of delamination, interlaminar shearing at midplane along the length of the specimen, and cross-laminar fracture. The failure behavior of these notched specimens in cross-laminar loading resembles that of unnotched specimens. The apparent fracture toughness in cross-laminar loading is found to be about 35 MPa sq rt m; this is superior to 7075-T6 Al alloy.

O.C.

A92-12146**METHYL-TERT-BUTYL ETHER AS A COMPONENT OF AVIATION GASOLINES (METIL-TRET-BUTILOVYI EFIR KAK KOMPONENT AVIATIONNYKH BENZINOV)**

V. E. EMEL'IANOV, P. S. DEINEKO, E. A. NIKITINA, and V. P. GREBENSHCHIKOV (VNII Neftianoi Promyshlennosti, Moscow, USSR) Khimiia i Tekhnologiiia Topliv i Masel (ISSN 0023-1169), no. 9, 1991, p. 12, 13. In Russian.

Copyright

The efficiency of methyl-tert-butyl ether (MTBE) as an antiknock additive and its effect on the quality of gasoline were investigated experimentally with a view to using MTBE as a component of commercial aviation gasolines. It is shown that MTBE is highly efficient as an antiknock additive but has a negative effect on the low-temperature fuel characteristics. This problem can be solved by adding ethyl Cellosolve (0.3 percent by mass) or tetrahydrofurfural (0.1 percent by mass) to gasolines containing 8 percent MTBE, which effectively prevents the formation of ice crystals at low temperatures.

V.L.

A92-12209**CALCULATION OF GAS COMBUSTION REGIMES IN A COUNTERFLOW VORTEX CHAMBER (RASCHET REZHIMOV SZHIGANIIA GAZA V PROTIVOTOCHNOI VIKHREVOI KAMERE)**

O. V. MATVIENKO, V. A. ARKHIPOV, and I. G. DIK (Nauchno-Issledovatel'skii Institut Prikladnoi Matematiki i Mekhaniki, Tomsk, USSR) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0869-1339), July-Aug. 1991, p. 85-89. In Russian. refs

Copyright

Results of a numerical study of combustion in a cylindrical counterflow vortex chamber are reported. In particular, attention is given to exothermal chemical reactions taking place during combustion, aerodynamic characteristics of the chamber, evolution of the swirling flow, and heat transfer during combustion. Although the discussion concerns laminar flow, the conclusions can be extended to turbulent flows.

V.L.

A92-13243**LDF THERMOPLASTIC COMPOSITES TECHNOLOGY**

IKE Y. CHANG and JAMES F. PRATTE (Du Pont de Nemours Fibers and Composites Development Center, Wilmington, DE) Journal of Thermoplastic Composite Materials (ISSN 0892-7057), vol. 4, July 1991, p. 227-252. refs

Copyright

An overview of the innovative LDF thermoplastic-composite technology is presented with emphasis on a discussion of the technology's fundamental basis and the performance of the composites' properties. The proprietary technology employs reinforcement of long aligned discontinuous fibers. The LDF composite technology is cost-effective for the manufacture of complex-shaped parts of aerospace structures. The LDF composites exhibit excellent mechanical properties comparable to that of the continuous fiber-reinforced counterpart, since the reinforcing long fibers with a thermoplastic matrix are well aligned. Mechanical test results with various LDF composites confirm the fundamental theory for noncontinuous fiber reinforcement describing the critical fiber length necessary to achieve efficient average stress transfer in a composite. The potential application of LDF composite technology for high-performance aerospace structural parts are discussed and the thermoplastic wing ribs fabricated for V-22 tiltrotor aircraft are demonstrated. P.D.

N92-10066*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

POLY 1, 2, 4-TRIAZOLES VIA AROMATIC NUCLEOPHILIC DISPLACEMENT Patent Application

JOHN W. CONNELL, inventor (to NASA), PAUL M. HERGENROTHER, inventor (to NASA), and PETER WOLF, inventor (to NASA) (Badische Anilin- und Soda-Fabrik A.G., Mogendorf, Germany, F.R.) 24 Jan. 1991 17 p (NASA-CASE-LAR-14440-1; NAS 1.71:LAR-14440-1; US-PATENT-APPL-SN-650336) Avail: NTIS HC/MF A03 CSCL 07/1

The primary object of this invention constitutes new compositions of matter and a new process to prepare poly(1,2,4-triazoles) (PT). It concerns new PT, novel monomers, and the process for preparing the same. Another object of the present invention is to provide new PT that are useful as composite matrix resins for aircraft and dielectric interlayers in electronic devices. Another object of the present invention is the composition of several new di(hydroxyphenyl)-1,2,4-triazole monomers. According to the present invention, the foregoing and additional objects were obtained by synthesizing PT by the nucleophilic displacement reaction of di(hydroxyphenyl)-1,2,4-triazole monomers with activated aromatic dihalides. The inherent viscosities of the PT ranged from 1.37 to 3.4 dL/g and the glass transition temperatures ranged from 192 to 216 C. One polymer exhibited a crystalline melting temperature of 377 C. Thermogravimetric analysis (TGA) showed no weight loss occurring below 300 C in air or nitrogen with a 5 percent weight loss occurring at approximately 500 C in air and nitrogen. The synthesis of the di(hydroxyphenyl)-1,2,4-triazole monomer is represented in an equation. The monomer can be prepared by either of the two routes shown. The chemistry can easily be extended to prepare similar di(hydroxyphenyl)-1,2,4-triazole monomers as shown in a second equation. The aromatic dihydrazides in some cases are commercially available or readily prepared from hydrazine and a di(acid chloride). The substitution of the hydroxy groups in either type of monomer may be meta-meta, para-para, or para-meta. The general reaction sequence of PT from each type of di(hydroxyphenyl)-1,2,4-triazole monomer is shown in equations 3 and 4. NASA

N92-10100# McDonnell Aircraft Co., Saint Louis, MO. **NONFLAMMABLE HYDRAULIC POWER SYSTEM FOR TACTICAL AIRCRAFT. VOLUME 2: EQUIPMENT AND SYSTEMS TEST AND EVALUATION Final Report, Jun. 1988 - Mar. 1990**

J. B. GREENE, M. A. ORF, J. J. SHEAHAN, J. A. WIELDT, and A. O. HARMON Apr. 1991 240 p (Contract F33615-86-C-2600) (AD-A239805; WRDC-TR-89-2026-VOL-2) Avail: NTIS HC/MF A11 CSCL 13/7

The objective of the Nonflammable Hydraulic Power System for Tactical Aircraft program was to develop and demonstrate an advanced hydraulic system design operating at a maximum pressure of 8000 psi using an Air Force Developed, nonflammable

fluid, chlorotrifluoroethylene (CTFE). It followed four previous programs directed at this technology at Boeing and MCAIR. It was further complemented by three other Air Force sponsored programs which embrace either 8000 psi, CTFE or both. These programs were conducted by Parker Bertea Aerospace (Seal Evaluation), by Vickers Incorporated (High Pressure Pump Development) and by Rockwell International (High Pressure Distribution System Evaluation). GRA

N92-11149*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EFFECTS OF ELEVATED TEMPERATURE ON THE VISCOPLASTIC MODELING OF GRAPHITE/POLYMERIC COMPOSITES

THOMAS S. GATES Oct. 1991 31 p Presented at ASTM Symposium on High Temperature and Environmental Effects on Polymeric Composites, San Diego, CA, 15 Oct. 1991 (NASA-TM-104160; NAS 1.15:104160) Avail: NTIS HC/MF A03 CSCL 11/4

To support the development of new materials for the design of next generation supersonic transports, a research program is underway at NASA to assess the long term durability of advanced polymer matrix composites (PMC's). One of main objectives of the program was to explore the effects of elevated temperature (23 to 200 C) on the constitutive model's material parameters. To achieve this goal, test data on the observed nonlinear, stress-strain behavior of IM7/5260 and IM7/8320 composites under tension and compression loading were collected and correlated against temperature. These tests, conducted under isothermal conditions using variable strain rates, included such phenomena as stress relaxation and short term creep. The second major goal was the verification of the model by comparison of analytical predictions and test results for off axis and angle ply laminates. Correlation between test and predicted behavior was performed for specimens of both material systems over a range of temperatures. Results indicated that the model provided reasonable predictions of material behavior in load or strain controlled tests. Periods of loading, unloading, stress relaxation, and creep were accounted for.

Author

N92-11203# Sandia National Labs., Albuquerque, NM. **LOW VOLATILE ORGANIC COMPOUND PAINTS**

F. E. MARTINEZ 1991 7 p Presented at the ECM 1991 Congress, Santa Fe, NM, 18-20 Sep. 1991 (Contract DE-AC04-76DP-00789) (DE91-017984; SAND-91-1894C; CONF-9109274-1) Avail: NTIS HC/MF A02

Increasingly stringent air emission standards in various states has dictated the elimination of engineering finishes which are derived from high volatile organic compound (VOC) paint chemistries. In July 1989, Allied-Signal, Inc., Kansas City Division, Kansas City, Missouri, voluntarily closed its paint facility, due to non-compliance with local air emission standards. The details of the materials selection and evaluations which led to current processing using low VOC paints, which permitted the Allied Signal, Inc., paint facility to achieve compliance and resume operations.

DOE

N92-11213# Pratt and Whitney Aircraft, West Palm Beach, FL. **PROPERTIES OF AIRCRAFT FUELS AND RELATED MATERIALS Final Report, 8 Jul. 1985 - 30 Nov. 1990**

TEDD B. BIDDLE 29 Jul. 1991 515 p (Contract F33615-85-C-2508) (AD-A240650; PWA-FR-21509; WL-TR-91-2036) Avail: NTIS HC/MF A22 CSCL 21/4

Topics of this technical study include: general analysis and characterization of conventional and experimental fuel properties which are unique and/or critical to engine performance and durability; special investigations; development and evaluation of new test methods; refinement of existing test methods; additive evaluation and quantification; investigation of fuel and material related field problems; advanced fuel requirements; and fuel system parameters for current and advanced engines. Specific topics

12 ENGINEERING

include: lubricity, thermal stability, vapor pressure, thermal conductivity, high density fuels, corrosion inhibitors, and combustion. GRA

12

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A92-10039

AEROTHERMODYNAMIC SYSTEMS ENGINEERING AND DESIGN

SAE Aerospace Information Report, AIR 1168/3, 1990, 144 p. refs
(SAE AIR 1168/3) Copyright

A reference source for various aspects of aerothermodynamic systems engineering and design is presented. Air conditioning load analysis is addressed, including physiological requirements, heat and cooling load equations, skin temperature computational methods, cooling loads due to radiation through transparent areas, heating and cooling loads due to internal sources, and practical considerations in the determination of overall heating and cooling loads. Refrigeration system design is considered, including air cycle systems, vapor cycle systems, combined vapor cycle and air cycle systems, and thermoelectric cooling. Heating methods is heating system design and low pressure and high pressure systems in air distribution system design are addressed. Procedures and equations commonly used for aerospace applications of these technologies are included. C.D.

A92-10102

ADVANCED MULTI-SQUEEZE FILM DAMPERS FOR ROTOR VIBRATION CONTROL

HOOSHANG HESHMAT and JAMES F. WALTON (Mechanical Technology, Inc., Latham, NY) STLE Tribology Transactions (ISSN 0569-8197), vol. 34, Oct. 1991, p. 489-496. refs
(Contract F33615-85-C-2518) Copyright

In this paper a novel, high load squeeze film damper design, supporting analysis, and experimental results are presented. The spiral foil multi-squeeze film damper demonstrated that two- to fourfold or larger increases in damping levels are possible without resorting to significantly decreased damper clearances. As a result, the nonlinearities associated with high eccentricity operation are avoided. Controlled orbit tests with a dual squeeze film configuration were completed and favorably compared with theoretical predictions. The ability to accommodate high steady state and transient imbalance conditions make this damper well suited to a wide range of rotating machinery, including aircraft gas turbine engines. Author

A92-10143

X-RAY COMPUTED TOMOGRAPHY OF COMPOSITES

RICHARD H. BOSSI, KAREN K. COOPRIDER, and GARY E. GEORGESON (Boeing Aerospace and Electronics, Seattle, WA) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 1. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 224-238. refs
Copyright

The application of X-ray computed tomography (CT) for the evaluation of various polymer matrix composite parts were investigated. An emphasis was placed on pultruded composite parts in an effort to evaluate CT as a real-time, on-line, nondestructive sampling method for the pultrusion process. In

addition, other composite fabrication techniques were examined, including hand layup, honeycomb, filament winding, 3D braid, and injection molding. Five different CT systems were used for the scanning. The results of this preliminary testing of composites lead to several conclusions. First, CT demonstrated significant potential for reducing time and costs in development cycles of composite manufacturing processes. Second, medical CT systems provided a cost-effective method of meeting pultrusion inspection needs for development and production. Finally, CT systems were shown to offer advantages in research applications for composites particularly as an alternative to destructive sectioning. Based on these studies, it is recommended that efforts be made to incorporate a medical CT system on a pultrusion system producing high criticality, aerospace components. Author

A92-10259

HIGH TEMPERATURE THERMOPLASTIC AND POLYIMIDE PROCESSING USING CARE-MOLD WASH-OUT TOOLING

JEFFREY T. HYNES (Composites Horizons, Inc., Covina, CA) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1950-1963. refs
Copyright

Advanced aircraft and spacecraft designs utilizing organic advanced composite materials has influenced the need for new fabrication technology. Cocuring and coconsolidation of high-temperature organic composites has been identified as an area that will grant designers flexibility and improvement in advanced aircraft designs. CARE-MOLD, a CAstable and REMovable wash-out tooling material, has been used to fabricate PMR-15 engine exhaust flaps and a high-temperature thermoplastic fighter Forward Fuselage section. The fabrication of these parts and others utilizing CARE-MOLD material is reviewed. Author

A92-10285

THE STUDY ON THE COMPOSITE-PATCHING REPAIRS FOR METALLIC AIRCRAFT STRUCTURES

CHING-LONG ONG and SHYAN B. SHEN (Aeronautical Research Laboratory, Taichung, Republic of China) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 2291-2305. refs
Copyright

Various factors affecting the use of composite-patching on cracked metallic aircraft structures are investigated. Attention is given to comparisons of the different patching materials, the repair efficiency of room-temperature versus high-temperature adhesives, and the reduced-temperature bonding versus standard bonding for high-temperature repairs. The effectiveness of the single-plate specimen repairs was confirmed by a tension-tension fatigue test of alclad 2024-T3 panels of 2.54-mm thickness. The tension-tension fatigue of patched panels was tested on Instron Model 1333, with 138-MPa peak stress, 10-Hz frequency, constant amplitude, 0.01 ratio, and sine wave cycling. It is shown that both boron/epoxy and graphite/epoxy composite patches, bonded with either room-temperature or high-temperature adhesives, attain enough fatigue cycles compared with damage tolerance requirements. They are suitable for the repair of structures under 2.5-mm thickness and provide a great degree of safety. P.D.

A92-10314

APPLICATIONS OF ADVANCED COMPOSITES IN A 3/4 AIR TRANSPORTABLE RACK

JOHN GLATZ, J. LEON, W. DITTMER (Sparta, Inc., San Diego, CA), and R. MORGAN (U.S. Navy, Naval Avionics Center, Indianapolis, IN) IN: Electronic materials - Our future; Proceedings of the 4th International SAMPE Electronic Materials and Processes Conference, Albuquerque, NM, June 12-14, 1990. Covina, CA, Society for the Advancement of Material and Processes Engineering, 1990, p. 108-121.
Copyright

Avionics enclosure and packaging technology is examined to

optimize the efficiency and maintainability of the systems without affecting avionics performance. The metal and resin-matrix composite design of the 3/4 Air Transportable Rack (3/4 ATR) is described which is intended to fulfill all system requirements, weigh less than other models, and optimize thermal management. The 3/4 ATR composed of advanced resin-and-metal-matrix composites is shown to fulfill all functional and environmental requirements of the Department of Defense. C.C.S.

A92-10375

APPLIED FRACTURE MECHANICS RESEARCH IN THE AEROSPACE FIELD

QINGZHI HE (Beijing Aeronautics and Astronautics University, People's Republic of China) National Conference on Fracture Mechanics, 6th, Fuyang, People's Republic of China, Apr. 1, 1991, Paper. 4 p. In Chinese.

Copyright

Research on methods for the computation of strength factors and crack extension in structural fatigue are presented. The thermal fatigue fracture of aircraft structure is addressed. Design for structural durability and composite-crack analysis are discussed.

Y.P.Q.

A92-10435* Sundstrand Corp., Rockford, IL.

MEASUREMENTS AND CORRELATION OF TWO-PHASE PRESSURE DROP UNDER MICROGRAVITY CONDITIONS

I. CHEN, R. DOWNING (Sundstrand Corp., Rockford, IL), E. G. KESHOCK, and M. AL-SHARIF (Tennessee, University, Knoxville) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 5, Oct.-Dec. 1991, p. 514-523. Previously cited in issue 09, p. 1326, Accession no. A89-25065. refs

(Contract NAS9-17195)

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A92-10445* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EVALUATION OF AN ADAPTIVE UNSTRUCTURED REMESHING TECHNIQUE FOR INTEGRATED FLUID-THERMAL-STRUCTURAL ANALYSIS

PRAMOTE DECHAUMPHAI (NASA, Langley Research Center, Hampton, VA) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 5, Oct.-Dec. 1991, p. 599-606. Previously cited in issue 06, p. 816, Accession no. A90-19911. refs

Copyright

A92-10654

BIENNIAL FLUID DYNAMICS SYMPOSIUM ON ADVANCED PROBLEMS AND METHODS IN FLUID MECHANICS, 19TH, KOZUBNIK, POLAND, SEPT. 3-8, 1989, SELECTED PAPERS

Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 42, no. 4-5, 1990, 205 p. For individual items see A92-10655 to A92-10663.

Copyright

Various papers on mechanics are presented. Individual topics addressed include: dynamics of the wall jet in transcritical regime, hydrodynamics of dispersions including diffusional effects, rotating disks flow under highly reduced gravity: infinite disks with different velocities rotating at moderate Re, formation of strong pressure pulses reflected from water-bubble layers, thermal-stress gas flows, generalized dynamical similarity numbers derived from Lagrangian's dynamics and Hamilton's canonical equations, numerical studies of Rayleigh-Taylor instability by the vortex method, splashing of drops, parameterization of the dissipation mechanisms in surface waves induced by wind. Also discussed are: Maxwell molecular collision model in kinetic theory of gases, two-layer flow stability of viscoelastic fluids in a circular pipe, shock wave reflection close to the leading edge of a wedge, thermocapillary flow in a rapidly rotating cylinder with a free inner surface, Liapunov's direct method in problems of fluid equilibrium instability, unsteady incompressible viscous flow past an airfoil, just-attached shock wave at the leading edge of a profile $M(\infty)$ greater than about one. C.D.

A92-10657

ON THERMAL-STRESS GAS FLOWS

O. G. FRIDLENDER (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers. A92-10654 01-34) Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 42, no. 4-5, 1990, p. 475-482. refs

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Slow (Re less than 1) nonisothermal gas flows at low Knudsen numbers are described by equations which contain the terms representing the thermal stress effect. However, since these terms constitute a part of the Burnett approximations, such a description of nonisothermal flows may be incorrect. Solutions of equations for slow nonisothermal gas flow (Kn going to 0) were compared with solutions of kinetic relaxation equation at low (but finite) Knudsen number to substantiate the proposed description; a problem of gas motion between parallel nonuniformly heated and cooled plates was solved. At decreasing Knudsen numbers, the kinetic equation solutions were shown to tend to the solutions of slow nonisothermal gas flow equations rather than to those of the Navier-Stokes equations. The possibility of experimental detection of the thermal stress effect is considered. Author

A92-10660

SHOCK WAVE REFLECTION CLOSE TO THE LEADING EDGE OF A WEDGE

B. SCHMIDT and J. FUCHS (Karlsruhe, Universitaet, Federal Republic of Germany) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers. A92-10654 01-34) Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 42, no. 4-5, 1990, p. 565-570. Research supported by DFG. refs

Copyright

A method for measuring the reflection of a moving shock wave from an inclined wedge under rarefied gas flow conditions using a shock tube is described. The data reduction method is also given. The results are compared with those of Honma and Henderson (1989) for a different flow using a shock tube method. C.D.

A92-10672

FRACTURE ANALYSIS ON COMPRESSOR BLADES

JIFENG TIAN, XINGZHI LIU (Chinese Academy of Sciences, Institute of Metal Research, Shenyang, People's Republic of China), and SHIZHONG CHEN (Institute of Aeroengine Research, Shenyang, People's Republic of China) International Journal of Fatigue (ISSN 0142-1123), vol. 13, July 1991, p. 333-336. refs

Copyright

An analysis of the failure of the blades of a compressor rotor is presented. The bending fracture of blade number 28 was created by a wake interaction between the rotary and stationary compressor blades. The cracking of the blade number 19 tenon was induced by fretting fatigue, while the combination of the twist stress with other stresses led to the transverse fracture of the same blade.

R.E.P.

A92-10673

THE MAINTENANCE ECONOMY AND ECONOMIC LIFE OF STRUCTURES

CHUAN-YAO CHEN and YOU-PING CHEN (Huazhong University of Science and Technology, Wuhan, People's Republic of China) International Journal of Fatigue (ISSN 0142-1123), vol. 13, July 1991, p. 337-340. refs

Copyright

To prevent structures with slow-growing cracks from resultant fatigue failure, a maintenance program is usually needed in current fatigue design procedures. A quantitative criterion to evaluate the maintenance economy of structures is presented, and it is determined that there is an economic repair period for the service time of structures. The definition of the economic life of structures on the basis of maintenance economy is discussed. R.E.P.

A92-10850

CALCULATION OF THE HARDENING FACTOR FOR GAS TURBINE ENGINE COMPONENTS SHOT BLASTED IN AN ULTRASONIC FIELD [RASCHET KOEFFITSIENTA UPROCHNENIIA DETALEI GTD SHARIKAMI V UL'TRAZVUKOVOM POLE]

V. K. IATSENKO (Zaporozhskii Mashinostroitel'nyi Institut, Zaporozhe, Ukrainian SSR) *Problemy Prochnosti* (ISSN 0556-171X), Aug. 1991, p. 78-81. In Russian. refs
Copyright

Experimental data are presented on the fatigue strength of gas turbine engine components made of EP718 and VT8 alloy which have been hardened by shot blasting in an ultrasonic field. By using the similarity theory and dimensional analysis, a model of the hardening factor is obtained which makes it possible to select the optimum conditions of the hardening treatment in an ultrasonic field and improve the accuracy of the strength margin calculation at the stage of process design. V.L.

A92-10963

STRESS ANALYSIS OF A PROPELLER BLADE

CHANGBING XIONG (Beijing University of Aeronautics and Astronautics, People's Republic of China) *Journal of Aerospace Power* (ISSN 1000-8055), vol. 6, Oct. 1991, p. 325-327. In Chinese.

The 3D FEM is applied to stress analysis of an original and the redesigned propeller blade taking loads, such as centrifugal and dynamical loads. In respect of stress distribution, the airfoil of the redesigned propeller blade is more reasonable. Its stress distribution approaches isostrength, and the safety coefficient also meets the given specification. Therefore, the redesigned propeller blade's design is quite advanced. Author

A92-10964

STRESS ANALYSIS OF A PROPELLER HUB

CHANGBING XIONG (Beijing University of Aeronautics and Astronautics, People's Republic of China) *Journal of Aerospace Power* (ISSN 1000-8055), vol. 6, Oct. 1991, p. 328-330. In Chinese.

The 3D FEM is applied to stress analysis of a propeller hub taking centrifugal load, aerodynamical moment, and blade centrifugal tension load into account. Since its construction is complicated, loads are various, and its stress distribution is hard to analyze, the elastic-stress-plus principle is employed for this purpose. The analytical results show that the blade's centrifugal tension load is predominant and its construction has been optimized to a certain extent due to current improvements during the long period of its service and modifications, so the stress distributions of its parts are quite even and reasonable. Author

A92-10965

DIGITAL SIMULATION AND EXPERIMENTAL MODAL ANALYSIS OF DYNAMIC CHARACTERISTICS OF A PROPELLER HUB

KEDONG LI and BINLAO DU (Beijing University of Aeronautics and Astronautics, People's Republic of China) *Journal of Aerospace Power* (ISSN 1000-8055), vol. 6, Oct. 1991, p. 331-336. In Chinese.

The FEM with 8-node 3D isoparametric elements and subspace iteration is applied to digital simulation of dynamic characteristics of a propeller hub. The sizes of the stiffness matrices K and mass matrices M in the equations are very large. The natural frequencies of the first six orders and its corresponding modes of the hub have been obtained from the experimental modal analysis. By comparison, the results of the experimental modal analysis and the digital simulation are of the same order. Author

A92-10967

VIBRATION CHARACTERISTIC ANALYSIS OF A PROPELLER BLADE

RUILIAN KONG and YANRONG WANG (Beijing University of Aeronautics and Astronautics, People's Republic of China) *Journal*

of Aerospace Power (ISSN 1000-8055), vol. 6, Oct. 1991, p. 342-344. In Chinese.

The subspace iteration method and Jacobi's method are used to solve the eigenvalue problem for the vibration of a propeller blade, in which the superparametric quadratic thick-shell element with eight nodes and 40 deg of freedom is used to govern the motion equation, considering the effects of shear transverse deformation on accuracy. The frequencies and vibration modes calculated by the present program are in quite good agreement with the experimental results, and they can be used to judge whether the resonance occurs in the operation of the propeller, taking only the effects of aerodynamic force excitation into account. Author

A92-10970

A SMALL FIVE-HOLE SPHERICAL PRESSURE PROBE FOR COMPRESSOR EXPERIMENTS

JIUKUN YAN and CHANGMING WU (Shenyang Aeroengine Research Institute, People's Republic of China) *Journal of Aerospace Power* (ISSN 1000-8055), vol. 6, Oct. 1991, p. 352-354. In Chinese. refs

A small five-hole spherical pressure probe instrumentation system is developed and applied to compressor interstage parameter measurement. This instrumentation system has two features: one is smallness of flow disturbance due to the small dimensions of the probe head; the other is an advanced data processing method which comprises a perfect probe calibration and data processing procedure. The analysis of the test results demonstrates that its performance is stable, and its accuracy and the data repeatability of its measurements are quite good. This instrumentation system can be applied to verification of the design parameters. Author

A92-11041

EMERGENCE OF COHERENT PATTERNS OF VORTEX STRETCHING DURING RECONNECTION - A SCATTERING PARADIGM

N. J. ZABUSKY, O. N. BORATAV, R. B. PELZ, M. GAO, D. SILVER, and S. P. COOPER (Rutgers University, Piscataway, NJ) *Physical Review Letters* (ISSN 0031-9007), vol. 67, Oct. 28, 1991, p. 2469-2472. refs

(Contract NSF DMS-89-01900; NSF EET-88-08780; AF-AFOSR-91-0248; N00014-90-J-1095; N00014-89-J-1320)

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Coherent patterns of the magnitude of the normalized vortex stretching vector were observed during the bursting reconnection phase of the evolution of identical initially orthogonally offset vortex tubes. It is proposed that the intensification and reconnection of initially tubelike vortex regions be viewed as a scattering process and that the topology of vortex lines during this phase of the process contributes to limiting vortex stretching (intensification). Furthermore, the use of these patterns (some rendered in color) as signatures of turbulent intermittency in exploring massive data sets is advocated. Author

A92-11219

TOPOLOGY OF STEADY FLOWS OF LOW VISCOSITY FLUIDS [TOPOLOGIE DES ECOULEMENTS PERMANENTS DE FLUIDES PEU VISQUEUX]

R. LEGENDRE (Academie des Sciences, Paris, France) *Revue Scientifique et Technique de la Defense* (ISSN 0994-1541), 1st Quarter, 1991, p. 67-75. In French. refs

Copyright

A study is presented to evaluate wind tunnel and water tunnel observations as shown in the tests performed on the Concorde wing. These tests revealed the eddies that required elimination to restrict drag and emitted noise. Consideration is given to the validity of topology rules for any continuous vector field. R.E.P.

A92-11288* Purdue Univ., West Lafayette, IN.

IMPELLER FLOW FIELD MEASUREMENT AND ANALYSIS

J. R. FAGAN and S. FLEETER (Purdue University, West Lafayette, IN) *ASME, Transactions, Journal of Turbomachinery* (ISSN

0889-504X), vol. 113, Oct. 1991, p. 670-679. Research supported by NASA. refs
(ASME PAPER 90-GT-146) Copyright

A series of experiments are performed to investigate and quantify the three-dimensional mean flow field in centrifugal compressor flow passages and to evaluate contemporary internal flow models. The experiments include the acquisition and analysis of LDV data in the impeller passages of a low-speed moderate-scale research mixed-flow centrifugal compressor operating at its design point. Predictions from a viscous internal flow model are then correlated with these data. The LDV data show the traditional jet-wake structure observed in many centrifugal compressors, with the wake observed along the shroud 70 percent of the length from the pressure to suction surface. The viscous model predicts the major flow phenomena. However, the correlations of the viscous predictions with the LDV data were poor. Author

A92-11344
OPTIMAL BOUNDARY CONTROL OF NONSTEADY INCOMPRESSIBLE FLOW WITH AN APPLICATION TO VISCOUS DRAG REDUCTION

T. P. SVOBODNY, M. D. GUNZBURGER, and L. S. HOU (Wright State University, Dayton, OH) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 377, 378.

Copyright

The objective of this study is to characterize the boundary velocity distribution that in some sense gives the lowest viscous drag for viscous, incompressible flows. The case is considered where the control is explicitly constrained. Necessary conditions are presented for optimal controls for the Navier-Stokes equations in a bounded region. An application to reducing viscous drag by blowing and suction is discussed. The first part of the study considers static control; the second part is concerned with time-varying optimal controls. I.E.

A92-11761
NUMERICAL SIMULATIONS OF UNSTEADY REACTIVE FLOWS IN A COMBUSTION CHAMBER

K. KAILASANATH, J. H. GARDNER, E. S. ORAN, and J. P. BORIS (U.S. Navy, Naval Research Laboratory, Washington, DC) Combustion and Flame (ISSN 0010-2180), vol. 86, July 1991, p. 115-134. Research supported by U.S. Navy. refs

Copyright

Time-dependent, compressible numerical simulations have been performed for the flowfield in an idealized ramjet that consists of an axisymmetric inlet and combustor and a choked nozzle, in order to study the instability induced by the interactions between large-scale vortex structures, acoustic waves, and chemical energy release. Nonreactive flow calculations show complex interactions; vortex shedding occurs at the natural instability frequency of the shear layer, although vortex mergings are affected by the acoustic frequencies of the system. For the particular reactive-flow case studied, energy release substantially alters the flowfield. O.C.

A92-11791
THREE-DIMENSIONAL FINITE-ELEMENT ANALYSIS OF INTERLAMINAR STRESSES IN THICK COMPOSITE LAMINATES

J. Y. KIM and C. S. HONG (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea) Computers and Structures (ISSN 0045-7949), vol. 40, no. 6, 1991, p. 1395-1404. refs

Copyright

The 3D finite element computer program with a substructure technique has been developed to analyze the interlaminar stresses in thick composite laminates. The effect of laminate thickness and stacking sequence of the interlaminar stresses near the free edge of solid laminates and the laminates with a circular hole has been investigated. It is found that interlaminar stresses are

governed by stacking sequence rather than laminate thickness. The boundary layer width does not increase with laminate thickness but with the number of plies in the repeating unit. O.G.

A92-11816
INVISCID SPATIAL STABILITY OF A THREE-DIMENSIONAL COMPRESSIBLE MIXING LAYER

C. E. GROSCH and T. L. JACKSON (Old Dominion University, Norfolk, VA) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 231, Oct. 1991, p. 35-50. refs

Copyright

The results of a study of the inviscid spatial stability of a parallel 3D compressible mixing layer are presented. The parameters of this investigation are: the Mach number of the fast stream, the ratio of the speed of the slow stream to that of the fast stream, the ratio of the temperature of the slow stream to that of the fast stream, the direction of the crossflow in the fast stream, the frequency, and the direction of the propagation of the disturbance wave. Stability characteristics of the flow as a function of these parameters are given. Theoretical results which show the interrelations between these parameters and their effects on the stability characteristics are presented. It is found that the 3D stability problem for a 3D mixing layer at Mach zero can be transformed to a 2D stability problem for an equivalent 2D mean flow. There exists a one-parameter family of curves such that for any given direction of mean flow and of wave propagation, this transformation can be applied and the growth rate can be obtained from the universal curves. C.A.B.

A92-11830
DYNAMIC CHARACTERIZATION AND IDENTIFICATION OF NONLINEAR SYSTEMS APPLICATION TO AERONAUTICAL STRUCTURES

MARC LEPART (ONERA, Chatillon, France) La Recherche Aeronautique (English Edition) (ISSN 0379-380X), no. 3, 1991, p. 23-32. refs

Copyright

An error function used to demonstrate the presence of nonlinear phenomena in the determination of the dynamic behavior of structures using curve fitting of frequency response functions is proposed. The function also characterizes the types of nonlinearities. The function serves as a criterion for the quality of curve fitting, helping the operator to choose a nonlinear model leading to the smallest error at the lowest computation cost. C.D.

A92-12115
COMPUTER SIMULATION OF WEAPON BLAST PRESSURES ON FLEXIBLE SURFACES

A. C. SINGHAL and D. S. LARSON (Arizona State University, Tempe) Computers and Structures (ISSN 0045-7949), vol. 41, no. 2, 1991, p. 325-330. Research supported by Arizona State University. refs

Copyright

A computer program is developed that calculates dynamic reduction factors based on the stiffness and mass distribution of various aerospace structures. The program includes the influence of flexibility, elastic modulus, mass distribution of the flexible surfaces, and different support conditions. Analytical closed-form solution is achieved using Duhamel integrals for impulse functions consisting of both positive and negative phases. Energy formulation is used to reduce continuous structures. The analytical results compare well with computer results which are based on numerical integration techniques. Author

A92-12290
POLISH RADAR TECHNOLOGY. II - ADAPTIVE RADAR AVIA CM

WIESLAW KLEMBOWSKI and JERZY PIKIELNY (Telecommunications Research Institute, Warsaw, Poland) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 27, Sept. 1991, p. 752-755.

Copyright

The main goals of new Polish L-band ATC radar for en route control (AVIA CM) are presented. The design concept is described. AVIA CM main technical parameters are given. Some qualitative comparisons between experimental coverage diagrams of AVIA C and AVIA CM are made. Author

A92-12291

POLISH RADAR TECHNOLOGY. III - WEATHER CHANNEL FOR PRIMARY SURVEILLANCE RADAR

WIESLAW KLEMBOWSKI (Telecommunications Research Institute, Warsaw, Poland) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 27, Sept. 1991, p. 755-758. Copyright

The general concept of weather channel, implemented into primary surveillance radar, is presented. The signal processing in weather channel and display of weather information are described. Some experimental results are discussed. Author

A92-12293

POLISH RADAR TECHNOLOGY. V - ADAPTIVE MTI FILTERS FOR UNIFORM AND STAGGERED SAMPLING

ANDRZEJ WOJTKIEWICZ and MICHAL TUSZYNSKI (Warsaw University of Technology, Poland) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 27, Sept. 1991, p. 760-767. Copyright

The research on adaptive MTI filters in Poland is concentrated in two areas: theory of frequency analysis and optimal adaptive processing of nonuniformly sampled signals and development of uniformly sampled robust-adaptive MTI (AMTI) filters which are not sensitive to adverse effects of adapting to the target signal. Results obtained in these areas are briefly presented. Author

A92-12299

ANALYSIS AND DESIGN OPTIMIZATION OF MONOPULSE RECEIVERS FOR SECONDARY SURVEILLANCE RADAR

KEVIN MCGRANE (Marconi Radar Systems, Ltd., Chelmsford, England) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 27, Sept. 1991, p. 838-852. refs Copyright

Monopulse techniques are widely employed for target location in air traffic control secondary surveillance radar systems. The sensitivity to calibration and component errors of the receiver configurations used in monopulse processing of secondary surveillance radar (SSR) replies is analyzed. The effects of video gain error in amplitude processors and large Gaussian perturbations in phase processors are introduced. Phase processors are shown to be robust to variations in antenna difference pattern null depth. A multi-angle phase processor is described which yields the benefits of phase processing without the sensitivity to system errors associated with conventional implementations. Author

A92-12346

EXPERIMENTAL DETERMINATION OF THE CENTRE OF MASS, THE PRINCIPAL CENTRAL AXES OF INERTIA AND MOMENTS OF INERTIA [DOSWIADCZALNE WYZNACZANIE POLOZENIA SRODKA MASY I GLOWNYCH CENTRALNYCH OSI BEZWLADNOSCI ORAZ WARTOSCI MOMENTOW BEZWLADNOSCI SAMOLOTU]

ANDRZEJ SWIDER (Instytut Lotnictwa, Warsaw, Poland) Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 124-125, 1991, p. 52-71. In Polish. refs

The methods presented make possible to determine experimentally the coordinates of the mass center and the principal central axes of inertia with an error assessment. Measurements are taken many times so that statistical results can be obtained. The center of mass is measured by the added mass method. It is based on the equilibrium deflection of a suspended aircraft caused by some additional masses. Coordinate values are computed from the deflection angles. In order to measure MI and the principal axes location a simple pendulum method is used. Multiple measurements for changed oscillation axes give a moment versus

deflection angle curve. It was used to determine the above parameters. The methods presented were tested on an aircraft model and then applied to real aircraft. Author

A92-12354

TRADITIONAL FINITE ELEMENT ANALYSIS - OPPORTUNITIES FOR PARALLELISM?

D. W. DEUERMEYER, G. A. CLIFFORD, and D. J. PETESCH (Cray Research, Inc., Eagan, MN) (Parallel methods on large-scale structural analysis and physics applications; Symposium, Hampton, VA, Feb. 5, 6, 1991, Selected Papers. A92-12351 02-61) Computing Systems in Engineering (ISSN 0956-0521), vol. 2, no. 2-3, 1991, p. 157-165. refs Copyright

Several large production MSC/NASTRAN FEA models are presented and their analysis is discussed in terms of how one might extract the inherent parallelism (if any) using a CRAY Y-MP supercomputer. The objective is to reduce the elapsed time for analysis. Comments are made as to the relative efficiencies of different modal extraction schemes for forced frequency response analysis. Author

A92-12422

ANALYSES OF HEAT ISOLATION PROPERTY FOR METALLIC MULTIWALL THERMAL PROTECTION SYSTEM

SEINOSUKE SUMI, MASAHIKO MUROZONO, KENICHI KUSHIKI, and MASAYUKI KUSAKABE (Kyushu University, Technology Reports (ISSN 0023-2718), vol. 64, Aug. 1991, p. 241-248. In Japanese. refs

Transient thermal analyses were carried out for a multiwall titanium thermal protection system (TPS) for the space transportation system, which consists of alternate flat and dimpled sheets which are welded together at the crests of the dimpled sheet, and formed into square tiles which are mechanically attached to the primary structure of the space transportation system. Three modes of heat transfer are considered: (1) conduction through the gas inside the tiles, (2) conduction through the metal, and (3) radiation between the adjoined sheets. Results of a steady state analysis of the three modes of heat transfer yield an effective thermal conductivity. The contributions of each mode of heat transfer to various parameters are shown. I.S.

A92-12625

ELECTORHEOLOGICAL FLUIDS; PROCEEDINGS OF THE 2ND INTERNATIONAL CONFERENCE, RALEIGH, NC, AUG. 7-9, 1989

J. D. CARLSON, ED. (Lord Corp., Thomas Lord Research Center, Cary, NC), A. F. SPRECHER, ED., and HANS CONRAD, ED. (North Carolina State University, Raleigh) Conference sponsored by North Carolina State University and Lord Corp. Lancaster, PA, Technomic Publishing Co., Inc., 1990, 466 p. No individual items are abstracted in this volume.

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The present conference on electrorheological fluids discusses ER fluid mechanisms and related fundamentals, ER fluid materials, characterization and property measurement, engineering with ER fluids, and ER fluid devices and applications. Attention is given to viscoelastic behavior of ER fluids, ER fluid modeling, possible phase transition in ERs, and measuring forces between particles in a model ER fluid. Topics addressed include miscellaneous ER phenomena, an overview of ER fluid design, tribological aspects of ER fluid behavior with respect to nonpolar base liquids, the role of water in ER fluids, and the electrorheology of the suspension of zeolite particles in silicone oil. Also discussed are applications of ER materials in vibration control, the control of damping in distributed systems using ER fluids, the fluid property and mechanical design considerations in ER-fluid clutches and brakes, devices using ER fluids, and a case study of tension control using ER fluids. C.A.B.

A92-12803

A METHOD FOR DETERMINING THE PARAMETERS OF MATHEMATICAL GENERALIZATIONS OF EXPERIMENTAL DATA ON CONVECTIVE HEAT TRANSFER [METODIKA OPREDELENIIA PARAMETROV MATEMATICHESKIKH OBOBSHCENII EKSPERIMENTAL'NYKH DANNYKH PO KONVEKTIVNOMU TEPLOOBMENU]

P. G. KRUKOVSKI, A. A. KHALATOV, and L. V. SYSKOV (AN USSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR) Promyshlennaya Tekhnika (ISSN 0204-3602), vol. 13, no. 3, 1991, p. 61-64. In Russian. refs

Copyright

A method and an algorithm are proposed for determining an arbitrary number of the parameters of arbitrary nonlinear mathematical descriptions of experimental data on convective heat transfer. The method is demonstrated by solving a test problem and processing experimental data on convective heat transfer in the blade passages of a gas turbine engine. The approach proposed here has been implemented in software. V.L.

A92-12828

SYNTHESIS OF THE ALGORITHM OF A SPATIAL-TEMPORAL DISCRIMINATOR AND THE POTENTIAL ACCURACY OF THE VELOCITY METER [SINTEZ ALGORITMA PROSTRANSTVENNO-VREMENNOGO DISKRIMINATORA I POTENTIAL'NAIA TOCHENOST' IZMERITELIA SKOROSTI]

E. I. ONOPRIENKO Radioelektronika (ISSN 0021-3470), vol. 34, July 1991, p. 44-48. In Russian. refs

Copyright

Statistical decision theory is used to obtain optimal algorithms for a spatial-temporal discriminator, i.e., a meter of the longitudinal and transverse components of the velocity vector of a flight vehicle with respect to the scattering surface. The proposed algorithm is shown to be more accurate than the optimal Doppler meter. L.M.

A92-13204* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

NUMERICAL SIMULATION OF THE ACTUATION SYSTEM FOR THE ALDF'S PROPULSION CONTROL VALVE

JOHN J. KORTE (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 700-705. Previously cited in issue 06, p. 827, Accession no. A90-19674. refs

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N92-10141# Test Group (6585th), Holloman AFB, NM. Ratscat Div.

THE USE AND MISUSE OF AIRCRAFT AND MISSILE RCS STATISTICS Final Report

LEE R. BISHOP 31 Jul. 1991 10 p (AD-A239892; RATSCAT-TM-91-001) Avail: NTIS HC/MF A02 CSCL 17/9

Both static and dynamic radar cross sections measurements are used for RCS predictions, but the static data are less complete than the dynamic. Integrated dynamics RCS data also have limitations for prediction radar detection performance. When raw static data are properly used, good first-order detection estimates are possible. The research to develop more-useable RCS statistics is reviewed, and windowing techniques for creating probability density functions from static RCS data are discussed. GRA

N92-10157# Coriolis Corp., Saratoga, CA.

THERMAL MANAGEMENT OF HIGH HEAT FLUX ELECTRONIC COMPONENTS IN SPACE AND AIRCRAFT SYSTEMS, PHASE 1 Final Report, 28 Sep. 1989 - 5 May 1990

ARTHUR H. IVERSEN 18 Mar. 1991 51 p (Contract F33615-89-C-2970)

(AD-A239982; WRDC-TR-90-2122-PHASE-1) Avail: NTIS HC/MF A04 CSCL 09/1

The objectives of this Phase 1 program were to analyze, design, construct and demonstrate the application of curved surface cooling to power devices with the goal of demonstrating greater

than 200 W/sq cm chip dissipation while maintaining junction temperatures within specification. Major components of the experiment comprised the test fixture for mounting the device under test and the cooling loop equipment and instrumentation. The work conducted in this Phase 1 study was to establish the basic parameters for the design of an entire class of efficient, compact, lightweight and cost competitive power conversion/conditioning systems for space, aircraft and general DOD requirements. This has been accomplished. Chip power dissipation of greater than 400 W/sq cm was demonstrated, and a general packaging and the thermal management design has been devised to meet the above requirements. The power limit reached was dictated by the junction temperature and not power dissipation, i.e., critical heat flux. The key to the packaging design is a basic construction concept that provides low junction to fluid thermal resistance. High heat flux dissipation without low thermal resistance is useless because excessive junction temperatures will result. GRA

N92-10163# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

NUMERICAL SIMULATION OF VORTEX BREAKDOWN BY SOLVING THE EULER EQUATIONS FOR AN INCOMPRESSIBLE FLUID

T. H. LE, P. MEGE, and Y. MORCHOISNE (Paris VI Univ., France) In its Numerical Simulation of Vortex Breakdown p 32-46 Jun. 1990 In FRENCH; ENGLISH summary Sponsored by Direction des Recherches, Etudes et Techniques Avail: NTIS HC/MF A04

A method of calculating unsteady, three dimensional flows of inviscid incompressible fluid was used in research on vortex breakdown. This method is based on the solution of the unsteady Euler equations in a velocity-pressure formulation, discretized by centered finite difference schemes, accurate to the second order. The application dealt with relates to a single vortex that has an initial velocity profile resembling delta wing vortices. Comparisons are made with experimental data and with other simulation methods. ESA

N92-10164# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

NUMERICAL SIMULATION OF VORTEX BREAKDOWN VIA 3-D EULER EQUATIONS

T. H. LE, P. MEGE, and Y. MORCHOISNE (Paris VI Univ., France) In its Numerical Simulation of Vortex Breakdown p 47-69 Jun. 1990 Presented at Turbulence 89, Grenoble, France, 18-21 Sep. 1989

Avail: NTIS HC/MF A04

The long term goal is the modeling of vortex breakdown that occurs in some aerodynamic configurations at high angle of attack, (i.e., fighters with highly swept delta wings or missiles). A numerical simulation was made based on solving the 3-D Euler equations for an unsteady incompressible flow. Preliminary results were obtained using a pressure-velocity formulation with periodic boundary conditions, the Euler equations being discretized by 2nd order finite difference schemes. The continuation to this work by implementing more realistic boundary conditions and 4th order finite difference discretization schemes are presented. ESA

N92-10174# Pittsburgh Energy Technology Center, PA.

STEADY FLOW OF A FLUID-SOLID MIXTURE IN A CIRCULAR CYLINDER

G. JOHNSON, K. R. RAJAGOPAL (Pittsburgh Univ., PA.), M. MASSOUDI, and M. P. MATHUR Sep. 1991 61 p Prepared in cooperation with Oak Ridge Associated Universities, Inc., TN (Contract DE-AC05-76OR-00033)

(DE91-018698; DOE/PETC-TR/91/10) Avail: NTIS HC/MF A04

A mathematical description for a flowing mixture of solid particulates and a fluid similar to a coal-water slurry, is developed within the context of Mixture Theory. Specifically, the equations governing the flow of a two-component mixture of a Newtonian fluid and a granular solid are derived. These relatively general equations are then reduced to a system of coupled ordinary differential equations describing steady flow of the mixture through

a pipe. The resulting boundary value problem is solved numerically and results are presented for cases in which drag and lift interactions are important. DOE

N92-10185* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

DUAL STRAIN GAGE BALANCE SYSTEM FOR MEASURING LIGHT LOADS Patent

PAUL W. ROBERTS, inventor (to NASA) 15 Oct. 1991 9 p
Filed 18 Sep. 1990 Supersedes N91-13687 (29 - 5, p 663)
(NASA-CASE-LAR-14419-1; US-PATENT-5,056,361;
US-PATENT-APPL-SN-584018; US-PATENT-CLASS-73-147;
US-PATENT-CLASS-73-862.04; US-PATENT-CLASS-73-862.65;
INT-PATENT-CLASS-G01L-5/16;
INT-PATENT-CLASS-G01M-9/00) Avail: US Patent and
Trademark Office CSCL 14/2

A dual strain gage balance system for measuring normal and axial forces and pitching moment of a metric airfoil model imparted by aerodynamic loads applied to the airfoil model during wind tunnel testing includes a pair of non-metric panels being rigidly connected to and extending towards each other from opposite sides of the wind tunnel, and a pair of strain gage balances, each connected to one of the non-metric panels and to one of the opposite ends of the metric airfoil model for mounting the metric airfoil model between the pair of non-metric panels. Each strain gage balance has a first measuring section for mounting a first strain gage bridge for measuring normal force and pitching moment and a second measuring section for mounting a second strain gage bridge for measuring axial force.

Official Gazette of the U.S. Patent and Trademark Office

N92-10206# Massachusetts Inst. of Tech., Cambridge. Acoustics and Vibration Lab.

THE MEASUREMENT OF PLATE VIBRATION AND SOUND RADIATION FROM A TURBULENT BOUNDARY LAYER MANIPULATOR

M. PHILLIPS, K. HERBERT, and P. LEEHEY 15 Aug. 1991 50 p
(Contract N00014-89-J-1176)
(AD-A240127; REPT-71435-2) Avail: NTIS HC/MF A03 CSCL 20/11

Two Boundary Layer Manipulators (BLM's) made of thin honeycombed aluminum were placed in a turbulent boundary layer flow. Sound intensity measurements were taken in order to determine the Mach number dependence of sound radiation. We found that sound intensity levels follow a power law consistent with dipole radiation. We made estimates of intensity levels for the BLM's in water using our measurements in air. Our estimates predict low radiation levels when mounted on naval vessels. Vibration levels were increased when undamped BLM's were installed in our wind tunnel facility. However, vibration levels were very low, and consequently sound radiation due to plate vibration was too low to be measured. Damping of the BLM's dramatically reduced vibration levels as well as direct radiation from the BLM's. GRA

N92-11235# Naval Postgraduate School, Monterey, CA.

THE DESIGN OF BROADBAND RADAR ABSORBING SURFACES M.S. Thesis

GO H. SUK Sep. 1990 70 p
(AD-A240521) Avail: NTIS HC/MF A04 CSCL 17/4

There has been a growing and widespread interest in radar absorbing material technology. As the name implies, radar absorbing materials or RAM's are coatings whose electric and magnetic properties have been selected to allow the absorption of microwave energy at discrete or broadband frequencies. In military applications low radar cross section (RCS) of a vehicle may be required in order to escape detection while a covert mission is being carried on. These requirements have led to the very low observable or stealth technology that reduces the probability of detection of an aircraft. The design of radar absorbing materials is limited by constraints on the allowable volume and weight of the surface coating, and it is difficult to design a broadband radar

absorbing structure in limited volume. This thesis investigates the use of lossy dielectric materials of high dielectric permittivity in multilayer composites for the production of low radar cross section (RCS). The analysis is done by computing the plane wave reflection coefficient at the exterior surface of the composite coating by means of a computer program which selects layer parameters which determine low reflection coefficients for electromagnetic radiation under constraint of limited layer thickness as well as maximum frequency bandwidth. Author (GRA)

N92-11237# Visidyne, Inc., Burlington, MA.
AIRCRAFT LIDAR SENSITIVITY STUDY FOR MEASURING WATER VAPOR

R. J. RIEDER and O. SHEPHERD 1 Apr. 1991 32 p
(Contract F19628-88-C-0013)
(AD-A240549; PL-TR-91-2074; SR-1) Avail: NTIS HC/MF A03 CSCL 04/2

The amount of water in the optical path between an airborne measurement platform and a target is responsible for the difference between the actual and the measurement target spectral radiance. In situ measurements of water vapor can be limited by outgassing from the sensor and/or its environment. A study was performed to investigate the use of lidar remote sensing techniques for the remote measurement of water vapor from a measurement aircraft such as the FISTA NKC-135A. GRA

N92-11287# Institut National des Sciences Appliquees de Rouen, Mont Saint Aignan (France). Lab. d'Energetique des Systemes et de Procédes.

THEORETICAL STUDY (LAGRANGIAN MODELING) OF TURBULENT PARTICULATE DISPERSION [ETUDE THEORIQUE (MODELISATION LAGRANGIENNE) DE LA DISPERSION PARTICULAIRE TURBULENTE]

A. BERLEMONT, M. S. GRANCHER, and P. DESJONQUERES 1990 48 p In FRENCH
(Contract DRET-88-218)
(ETN-91-99909) Avail: NTIS HC/MF A03

A study aimed at improving the prediction and knowledge of two phase phenomena in a turbomachine is presented. A code to three dimensionally simulate particle dispersion, taking account of turbulent droplet evaporation, and which can be easily integrated into the DIAMANT code, is developed. Lagrangian modeling of particle dispersion is used. The influence of turbulence on evaporation appears to be non-negligible and must therefore be taken into account in droplet turbulent transfer problems. ESA

N92-11297*# United Technologies Research Center, East Hartford, CT.

THE EFFECTS OF REYNOLDS NUMBER, ROTOR INCIDENCE ANGLE AND SURFACE ROUGHNESS ON THE HEAT TRANSFER DISTRIBUTION IN A LARGE-SCALE TURBINE ROTOR PASSAGE Final Report

M. F. BLAIR Nov. 1991 228 p Original contains color illustrations
(Contract NAS8-38870)
(NASA-CR-184260; NAS 1.26:184260; UTRC/R91-970057-3)
Avail: NTIS HC/MF A11; 5 functional color pages CSCL 20/4

A combined experimental and computational program was conducted to examine the heat transfer distribution in a turbine rotor passage geometrically similar to the Space Shuttle Main Engine (SSME) High Pressure Fuel Turbopump (HPFTP). Heat transfer was measured and computed for both the full span suction and pressure surfaces of the rotor airfoil as well as for the hub endwall surface. The objective of the program was to provide a benchmark-quality database for the assessment of rotor heat transfer computational techniques. The experimental portion of the study was conducted in a large scale, ambient temperature, rotating turbine model. The computational portion consisted of the application of a well-posed parabolized Navier-Stokes analysis of the calculation of the three-dimensional viscous flow through ducts simulating a gas turbine package. The results of this assessment indicate that the procedure has the potential to predict the aerodynamics and the heat transfer in a gas turbine passage and

can be used to develop detailed three dimensional turbulence models for the prediction of skin friction and heat transfer in complex three dimensional flow passages. Author

N92-11307# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Aerodynamique. **RESOLUTION OF THE NAVIER-STOKES EQUATIONS APPLIED TO THE COMPUTATION OF THE LAMINAR FLOW AROUND A TWO DIMENSIONAL WING PROFILE [RESOLUTION DES EQUATIONS DE NAVIER-STOKES APPLIQUEE AU CALCUL DE L'ECOLEMENT LAMINAIRE AUTOUR D'UN PROFIL D'AILE BIDIMENSIONNEL]**

X. DESAINT-VICTOR Dec. 1990 48 p In FRENCH (CERT-RT-65/5604-35; ETN-91-90080) Avail: NTIS HC/MF A03

A two dimensional Navier-Stokes equation computation code of the laminar flow around a wing profile is presented. The equations are discretized by finite volume method. The motion quantity equations are resolved by an alternate direction method and the pressure correction equation by the conjugate gradient method with preconditioning. Results of calculations on a NACA0012 and an AS239 profile at different incidences are presented. A comparison with a boundary layer computation code is carried out. ESA

N92-11309# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Aerothermodynamique.

TURBULENT FRICTION DRAG REDUCTION: BOUNDARY LAYER MANIPULATORS Final Summary Report [REDUCTION DE TRAINEE DE FROTTEMENT TURBULENT: MANIPULATEURS DE COUCHE LIMITE. RAPPORT DE SYNTHESE FINAL]

E. COUSTOLS Mar. 1990 61 p In FRENCH (Contract STPA-85-95-009-51) (CERT-RSF-DERAT-62/5004-31; ETN-91-90085) Avail: NTIS HC/MF A04

Internal manipulation by slant of thin longitudinal riblets is addressed experimentally in three dimensional flow. An ONERA D profile mounted between the lateral walls of a subsonic wind tunnel is maintained at an angle sweep of 22.5 degrees and at incidence 0 degrees. When the profile is recovered by different models of ribleted walls the variations on the drag coefficient are estimated by wake explorations and compared to the drag of the profile encased in a smooth sheet of equivalent thickness. ESA

N92-11310# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.

RESOLUTION OF NAVIER-STOKES EQUATIONS AROUND PROFILES: DRAG EVOLUTION [RESOLUTION DES EQUATIONS DE NAVIER-STOKES AUTOUR DE PROFILS: EVALUATION DE LA TRAINEE. RAPPORT TECHNIQUE DE SYNTHESE]

F. MONTIGNY-RANNOU and J. P. VEUILLLOT Sep. 1990 51 p In FRENCH (Contract DRET-89-34-001) (ONERA-RTS-86/1685-AY-156A; ETN-91-90086) Avail: NTIS HC/MF A04

Modifications on the two dimensional Navier-Stokes equations resolution code are presented. A numerical viscosity model was introduced which allowed more difficult cases than before to be addressed. The drag around supercritical profiles is evaluated transonically and at low speeds. A comparison with experimental results is presented. Difficulties encountered are outlined and paths to explore are described. ESA

N92-11311# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.

PERFECT COMPRESSIBLE TWO DIMENSIONAL BOUNDARY LAYER STRONG FLUID COUPLING IN THE CASE OF SHARP LEADING EDGE PROFILES. UNSTEADY CASE OF ISOLATED PROFILES AND STEADY CASE OF BLADE GRIDS Final Report [COUPLAGE FORT FLUIDE PARFAIT-COUCHE LIMITE 2D COMPRESSIBLE DANS LE CAS DES PROFILS A BORD D'ATTAQUE AIGU. CAS INSTATIONNAIRE DES PROFILS ISOLEES ET CAS STATIONNAIRE DES GRILLES D'AUBES]

C. SOIZE Jan. 1991 73 p In FRENCH (Contract DRET-89-34-01) (ONERA-RT-43/1621-RY-006-R; ETN-91-90094) Avail: NTIS HC/MF A04

In the frame of studies of blade grid aeroelasticity, the perfect boundary layer strong fluid coupling is studied, the outer boundary layer being disengaged in leading edge and reengaged over the profile. The study is the fifth phase of a study to understand the development of the compressible code and its experimental validation, for unsteady isolated profiles and steady blade grids. ESA

N92-11312# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.

HYDRODYNAMIC FLOW VISUALIZATION AROUND AN OSCILLATING VANE. EXTENSION OF STUDY TO THE CASE OF HIGHER INCIDENCES AND AMPLITUDES AND THE STARTING OFF PHASE FROM PERMANENT REGIME [VISUALISATION HYDRODYNAMIQUE DE L'ECOLEMENT AUTOUR D'UNE PALE OSCILLANTE. EXTENSION DE L'ETUDE AU CAS DES INCIDENCES ET AMPLITUDE ELEVEES A LA PHASE DE MISE EN MOUVEMENT A PARTIR DU REGIME PERMANENT]

H. WERLE Jan. 1976 41 p In FRENCH (ONERA-RT-56/1369-AN; ETN-91-90095) Avail: NTIS HC/MF A03

Visualizations obtained in a hydrodynamic tunnel contributed to the specification of the running of phenomena characterizing the unsteady breakdown on a profile under large amplitude harmonic oscillations. The starting phase of the oscillations was observed around a minimally zero incidence starting off profile and compared to the well established periodic regime; the visualizations further reveal the evolution of the phenomena as a function of the Reynolds number, the frequency and amplitude of the oscillations as well as the influence of the pitching and mean incidence axis position. ESA

N92-11319*# Calspan-Buffalo Univ. Research Center, NY.

STUDIES OF AEROTHERMAL LOADS GENERATED IN REGIONS OF SHOCK/SHOCK INTERACTION IN HYPERSONIC FLOW Final Report

MICHAEL S. HOLDEN, JOHN R. MOSELLE, and JINHO LEE Oct. 1991 339 p (Contract NAS1-17721) (NASA-CR-181893; NAS 1.26:181893) Avail: NTIS HC/MF A15 CSCL 20/4

Experimental studies were conducted to examine the aerothermal characteristics of shock/shock/boundary layer interaction regions generated by single and multiple incident shocks. The presented experimental studies were conducted over a Mach number range from 6 to 19 for a range of Reynolds numbers to obtain both laminar and turbulent interaction regions. Detailed heat transfer and pressure measurements were made for a range of interaction types and incident shock strengths over a transverse cylinder, with emphasis on the 3 and 4 type interaction regions. The measurements were compared with the simple Edney, Keyes, and Hains models for a range of interaction configurations and freestream conditions. The complex flowfields and aerothermal loads generated by multiple-shock impingement, while not generating as large peak loads, provide important test cases for code prediction. The detailed heat transfer and pressure measurements proved a good basis for evaluating the accuracy

of simple prediction methods and detailed numerical solutions for laminar and transitional regions or shock/shock interactions.

Author

N92-11328*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EULER SOLUTIONS FOR AN UNBLADED JET ENGINE CONFIGURATION

MARK E. M. STEWART 1991 9 p Proposed for presentation at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1991; sponsored by AIAA (Contract NASA ORDER C-99066-G) (NASA-TM-105332; ICOMP-91-23; E-6695; NAS 1.15:105332) Avail: NTIS HC/MF A02 CSCL 20/4

A Euler solution for an axisymmetric jet engine configuration without blade effects is presented. The Euler equations are solved on a multiblock grid which covers a domain including the inlet, bypass duct, core passage, nozzle, and the far field surrounding the engine. The simulation is verified by considering five theoretical properties of the solution. The solution demonstrates both multiblock grid generation techniques and a foundation for a full jet engine throughflow calculation.

Author

N92-11367# Netrologic, Inc., San Diego, CA.

ROBOTIC NON-DESTRUCTIVE INSPECTION OF AIRCRAFT, PHASE 1 Final Report

JOEL DAVIS 5 Sep. 1991 39 p

(Contract N00014-91-C-0095)

(AD-A240777) Avail: NTIS HC/MF A03 CSCL 01/3

Non-Destructive Inspection (NDI) of aircraft is known to be a time consuming, boring, and an error prone task for human inspectors. A method is needed for looking (inspecting) at an aircraft without reliability problems due to boredom while minimizing aircraft total inspection time during the life of the aircraft. The application of robotics to the NDI of aircraft was investigated. It was found that it is feasible to transform the Navy's robotic deriveter to a neural network based NDI robot. A feedforward multilayer neural network was found to be very reliable at detecting cracks around rivets. In addition, an efficient new manipulator path planning method using neural networks was found to be useful for the robotic aircraft NDI.

GRA

N92-11376# Aeronautical Research Labs., Melbourne (Australia).

CRITICAL APPRAISAL OF THE MCDONNELL DOUGLAS CLOSURE MODEL FOR PREDICTING FATIGUE CRACK GROWTH

M. J. BOS Sep. 1991 93 p

(ARL-STRUC-R-444; AR-006-626) Copyright Avail: NTIS HC/MF A05

The McDonnell-Douglas fatigue crack growth model CNTKM8 has been used to predict crack growth in Carbon-Carbon Technology (CCT) specimens with through cracks under four different load sequences, including a flight-by-flight sequence and two stress levels. The predictions were compared against experimental data. The results ranged from fairly good for the more structured sequences to rather poor for the more random sequences. The experimental trend of the structured sequences was not predicted correctly. An enhanced model was proposed and tested. The predictions of this model were more consistent with the experimental data, and the above mentioned experimental trend was also predicted correctly.

Author

N92-11377*# Technion Research and Development Foundation Ltd., Haifa (Israel). Faculty of Aerospace Engineering.

MULTI-DISCIPLINARY OPTIMIZATION OF AEROSERVOELASTIC SYSTEMS Annual Report, 1 Oct. 1990 - 30 Sep. 1991

MORDECHAY KARPEL 21 Oct. 1991 18 p

(Contract NAGW-1708)

(NASA-CR-188983; NAS 1.26:188983; REPT-160-573) Avail:

NTIS HC/MF A03 CSCL 20/11

New methods were developed for efficient aeroservoelastic

analysis and optimization. The main target was to develop a method for investigating large structural variations using a single set of modal coordinates. This task was accomplished by basing the structural modal coordinates on normal modes calculated with a set of fictitious masses loading the locations of anticipated structural changes. The following subject areas are covered: (1) modal coordinates for aeroelastic analysis with large local structural variations; and (2) time simulation of flutter with large stiffness changes.

Author

N92-11378*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

ADVANCED STRESS ANALYSIS METHODS APPLICABLE TO TURBINE ENGINE STRUCTURES Final Report

THEODORE H. H. PIAN Oct. 1991 43 p

(Contract NAG3-33)

(NASA-CR-187235; NAS 1.26:187235) Avail: NTIS HC/MF A03 CSCL 20/11

The following tasks on the study of advanced stress analysis methods applicable to turbine engine structures are described: (1) constructions of special elements which contain traction-free circular boundaries; (2) formulation of new version of mixed variational principles and new version of hybrid stress elements; (3) establishment of methods for suppression of kinematic deformation modes; (4) construction of semiLoof plate and shell elements by assumed stress hybrid method; and (5) elastic-plastic analysis by viscoplasticity theory using the mechanical subelement model.

Author

N92-11379*# Akron Univ., OH. Dept. of Mechanical and Civil Engineering.

ENGINE DYNAMIC ANALYSIS WITH GENERAL NONLINEAR FINITE ELEMENT CODES Final Report

M. L. ADAMS, J. PADOVAN, and D. G. FERTIS Oct. 1991 93 p

(Contract NSG-3283)

(NASA-CR-187222; NAS 1.26:187222) Avail: NTIS HC/MF A05 CSCL 20/11

A general engine dynamic analysis as a standard design study computational tool is described for the prediction and understanding of complex engine dynamic behavior. Improved definition of engine dynamic response provides valuable information and insights leading to reduced maintenance and overhaul costs on existing engine configurations. Application of advanced engine dynamic simulation methods provides a considerable cost reduction in the development of new engine designs by eliminating some of the trial and error process done with engine hardware development.

Author

N92-11383# Wright Lab., Wright-Patterson AFB, OH.

NONLINEAR ASPECTS OF AEROSPACE STRUCTURES AT HIGH EXCITATION LEVELS FLAT ALUMINUM BEAMS AND PLATES STUDIED Progress Report, Oct. 1989 - Sep. 1990

HOWARD F. WOLFE May 1991 61 p

(AD-A240600; WL-TM-91-311-FIBG) Avail: NTIS HC/MF A04 CSCL 13/13

Nonlinear multimodal response of flat aluminum clamped beams and plates was studied theoretically and experimentally together with associated signal processing effects. Theoretical models were evaluated to determine the various methods investigated and which methods might yield new information if further development with specific applications were pursued. The test methods and transducer suitability were carefully scrutinized. Beam tests were performed with sinusoidal and random excitation using a coil-magnet exciter. Clamped flat plate tests were performed using high intensity acoustic excitation from low levels to high levels. Data processing and analysis were investigated to determine their suitability. The hard spring nonlinearity or jump phenomena was apparent from the beam test results. The beam and plate were instrumented to separate the bending and axial components from the total strain. Displacement shapes of the beam were completed. The beam tests and the acoustic tests with the plate have been completed.

GRA

N92-11391*# Washington Univ., Seattle.

THERMOVISCOPLASTIC RESPONSE OF TI-15-3 UNDER VARIOUS LOADING CONDITIONS

M. E. TUTTLE and J. ROGACKI Oct. 1991 151 p

(Contract NAG1-974)

(NASA-CR-187621; NAS 1.26:187621) Avail: NTIS HC/MF A08 CSDL 20/11

Metal matrix composites (MMC's) are candidate materials for use in high temperature, high loading applications. In particular, an MMC consisting of a titanium alloy reinforced with silicon-carbide fibers is being considered for use on the National Aerospace Plane (NASP). Compared to other metals and metallic alloys, titanium alloys retain relatively high stiffness, strength, and corrosion resistance at elevated temperatures. However, above roughly 316 C titanium exhibits a significant thermoviscoplastic (creep) response. Since the temperatures encountered in many regions of the NASP are expected to exceed 316 C, the potential thermoviscoplastic behavior of titanium-based MMC's at elevated temperatures must be thoroughly investigated. Author

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A92-10489

BOUNDARY-LAYER TRANSITION ACROSS A STRATOCUMULUS CLOUD EDGE IN A COASTAL ZONE

C. E. SKUPNIEWICZ, J. W. GLENDENING, and R. F. KAMADA (U.S. Naval Postgraduate School, Monterey, CA) Monthly Weather Review (ISSN 0027-0644), vol. 119, Oct. 1991, p. 2337-2357. Research supported by USAF. refs

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The lateral transition from a stratocumulus-covered boundary layer to a clear-sky convective boundary layer during onshore flow in a coastal environment, using both mobile sodar observations and a numerical model is examined. During four observation periods, the vertically averaged wind speed increases by roughly a factor of 2 within 5 km of the cloud edge, and the boundary-layer-averaged wind direction backs 40-60 deg. The numerical predictions, driven by horizontal heat flux differences between cloudy- and clear-sky regions, agree quantitatively with both the observed wind speedup near the cloud edge and the observed boundary-layer growth, but the wind direction backing is underpredicted. In both observations and predictions, the surface wind speed maximum moves inland with time, whereas the boundary-layer-averaged wind speed maximum remains at the cloud edge. At the cloud edge, a predicted subsidence maximum coincides with an observed dip in boundary-layer depth. In the clear-sky region, concomitant rising motion - not entrainment - is primarily responsible for the rapid boundary-layer growth with distance. An energy balance approach, which neglects this upward motion, greatly underpredicts boundary-layer growth. The sodar indicates regions of strong wind shear under the clouds, but shear of that magnitude is not predicted by the model. Author

A92-11378

CHARACTERISTICS OF THUNDERSTORM-GENERATED LOW ALTITUDE WIND SHEAR - A SURVEY BASED ON NATIONWIDE TERMINAL DOPPLER WEATHER RADAR TESTBED MEASUREMENTS

M. WOLFSON, D. KLINGLE-WILSON, M. DONOVAN, J. CULLEN, D. NEILLEY, M. LIEPINS, R. HALLOWELL, J. DISTEFANO, D. CLARK, M. ISAMINGER (MIT, Lexington, MA) et al. IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical

and Electronics Engineers, Inc., 1990, p. 682-688. refs

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The characteristics of microbursts and gust fronts, two forms of aviation-hazardous low altitude wind shear, are presented. Data were collected with a prototype terminal Doppler weather radar and a network of surface weather stations in Memphis, Huntsville, Denver, Kansas City, and Orlando. Regional differences and features that could be exploited in detection systems such as the associated reflectivity, surface wind shear, and temperature change are emphasized. I.E.

A92-12844

SEVERAL RESULTS OF LIDAR MEASUREMENTS OF THE CHARACTERISTICS OF OBLIQUE VISIBILITY AT AN AIRFIELD [NEKOTORYE REZULTATY LIDARNOGO OPREDELENIYA KHAARAKTERISTIK NAKLONNOI VIDIMOSTI NA AERODROME]

E. E. RYBAKOV, V. A. KOVALEV, A. S. PAK, E. E. MOZHAROV, and G. N. BALDENKOV (Glavnaia Geofizicheskaya Observatoriya, St. Petersburg; NPO Zenit, USSR) Meteorologiya i Gidrologiya (ISSN 0130-2906), Sept. 1991, p. 18-25. In Russian. refs

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In 1989, data of the Elektronika-O6R lidar oblique visibility meter were compared with visual observations made on board aircraft at the moment of landing at the Ulianovsk airport. Lidar data were also compared to those of the RWO standard lower-cloud-boundary recorder, which is part of the CRAMS station kit. The diagram of the equipment layout on the airfield is given, and the results obtained are considered. The lidar sounding data are in good agreement with visual observations on board aircraft. P.D.

A92-12941 Atmospheric and Environmental Research, Inc., Cambridge, MA.

IMPACT OF HETEROGENEOUS CHEMISTRY ON MODEL-CALCULATED OZONE CHANGE DUE TO HIGH SPEED CIVIL TRANSPORT AIRCRAFT

DEBRA K. WEISENSTEIN, MALCOLM K. W. KO, JOSE M. RODRIGUEZ, and NIEN-DAK SZE (Atmospheric and Environmental Research, Inc., Cambridge, MA) Geophysical Research Letters (ISSN 0094-8276), vol. 18, Nov. 1991, p. 1991-1994. refs (Contract NAS1-19192; NASW-4162)

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Heterogeneous chemistry could have a very significant effect on the predicted impact of engine exhaust from high speed civil transport (HSCT) aircraft on atmospheric ozone. Two-dimensional models including only gas phase chemistry indicate that deposition of nitrogen oxides from aircraft exhaust in the lower stratosphere would significantly perturb the natural nitrogen budget, most likely resulting in ozone depletion. The model calculates that an injection of 1 megaton of NO₂ per year at 17-20 km would decrease the column ozone by 3-6 percent at northern midlatitudes using gas phase chemistry only. Inclusion of the reaction N₂O₅ + H₂O → 2HNO₃ acting on the global sulfate aerosol layer greatly decreases the sensitivity of ozone to injection of nitrogen oxides, with the calculated ozone column increasing by up to 0.4 percent for the same emission scenario. Additional simulations showed that this response is only slightly sensitivity to changes in chlorine content and aerosol loading. Author

N92-11578# Federal Aviation Administration, Washington, DC. Office of Environment and Energy.

EDMS: MICROCOMPUTER POLLUTION MODEL FOR CIVILIAN AIRPORTS AND AIR FORCE BASES, (USER'S GUIDE)

H. M. SEGAL Jun. 1991 53 p Supersedes DOT/FAA/EE-88-6 Sponsored by AFESC

(AD-A240528; DOT/FAA/EE-91-3; ESL-TR-91-31;

DOT/FAA/EE-88-6) Avail: NTIS HC/MF A04 CSDL 24/1

Before starting an airfield improvement project or changing the numbers, types, or activity of aircraft at an airfield, an air quality assessment is usually required. This assessment is usually made with an emissions/dispersion model. Two emissions/dispersion models were developed in the early 1970s

for use at airports and airbases. The United States Air Force (USAF) developed the Air Quality Assessment Model (AQAM) (Rote, et al., 1975), and the Federal Aviation Administration (FAA) developed the Airport Vicinity Air Pollution model (AVAP) (Wang, et al., 1973). However, these models are obsolete (they are expensive to operate, tedious to enter data into), and since they were not approved by the Environmental Protection Agency, had to be sold for each application. Both the FAA and the USAF noticed that microcomputer advances of the 1980s' could significantly improve airfield modeling. They also noticed that the FAA's and the USAF's modeling requirements were quite similar. It was therefore concluded that the FAA and the USAF should join forces to develop a single modeling system that both agencies could use. This single modeling system is called the Emissions and Dispersion Modeling System (EDMS). EDMS is a refined model designed for use on a microcomputer. It employs special table lookup and numerical integration procedures to permit a microcomputer to perform the tasks that had previously been done on a mainframe computer. GFA

N92-11593*# Federal Aviation Administration, Washington, DC.
PILOT'S AUTOMATED WEATHER SUPPORT SYSTEM (PAWSS) CONCEPTS DEMONSTRATION PROJECT. PHASE 1: PILOT'S WEATHER INFORMATION REQUIREMENTS AND IMPLICATIONS FOR WEATHER DATA SYSTEMS DESIGN
 Interim Report, Dec. 1990 - Apr. 1991

NORMAN L. CRABILL and ERNIE R. DASH Apr. 1991 19 p
 Sponsored in part by Diversified International Sciences Corp., Lanham, MD, and by Vigyan Research Associates, Inc., Hampton, VA
 (Contract NAS1-18585; DTFA01-90-4-01019)
 (NASA-CR-188228; NAS 1.26:188228; DOT/FAA/RD-91/9)
 Avail: NTIS HC/MF A03 CSCL 04/2

The weather information requirements for pilots and the deficiencies of the current aviation weather support system in meeting these requirements are defined. As the amount of data available to pilots increases significantly in the near future, expert system technology will be needed to assist pilots in assimilating that information. Some other desirable characteristics of an automation-assisted system for weather data acquisition, dissemination, and assimilation are also described. Author

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LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.

A92-11164
AN ANTHROPOMETRIC EVALUATION OF THE TH-57 JETRANGER HELICOPTER

ROBERT C. CHAPLESKI and EDWARD D. ADRIAN (Louisiana State University, Baton Rouge) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 1. Santa Monica, CA, Human Factors Society, 1990, p. 710-714. refs
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Results of a questionnaire and field study evaluating the TH-57 Jetranger helicopter are summarized. The questionnaire was distributed among student pilots asking their opinions on the operation of the helicopter. The problem with a cramped cockpit environment, obstructed visibility, difficulties in reaching and even seeing some instruments and gages, and several comfortability factors were revealed. The field test indicated that this helicopter is deficient in accommodating individuals within the allowable anthropometric ranges for student pilots. O.G.

A92-11191

A MODEL FOR EVALUATION AND TRAINING IN AIRCREW COORDINATION AND COCKPIT RESOURCE MANAGEMENT

ROBERT SIMON, DANIEL T. RISSER, EUGENE A. PAWLIK, SR. (Dynamics Research Corp., Wilmington, MA), and DENNIS K. LEEDOM (U.S. Army, Research Institute, Fort Rucker, AL) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1377-1381. refs
 (Contract DAHC35-89-D-0030)
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Measures of aircrew coordination for analytical use are proposed to address the need for an aircrew-coordination framework based on attitudes and behavior. The conceptual framework for operator behaviors is presented in which consideration is given to both alternative decision-making models and task 'coupling'. The evaluation of the framework is conducted by means of a questionnaire, an aircrew-coordination evaluation checklist, and revised aircrew training manual tasks. The model is reported to be in use in aircrew coordination evaluations of 20 Black Hawk helicopter crews, and the methods are being applied to the investigation of accidents. The methods presented are concluded to be more coherent and rigorous measures of cockpit resource management and aircrew coordination than previously employed methods. C.C.S.

A92-11204

EFFECTS OF VARIATIONS IN HEAD-UP DISPLAY AIRSPEED AND ALTITUDE REPRESENTATIONS ON BASIC FLIGHT PERFORMANCE

WILLIAM R. ERCOLINE (Krug Life Sciences, Brooks AFB, TX) and KENT K. GILLINGHAM (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1547-1551. refs
 Copyright

Five different HUD altitude and airspeed symbol sets are examined for efficacy in a basic instrument crosscheck during visually simulated flight. Altitude and airspeed were varied during the flight profile, requiring the pilots to recognize deviations and correct back to target conditions. Rms performance errors (deviations from assigned altitude and airspeed) were measured. The pilots' altitude and airspeed control was significantly better with two new formats, rotating pointers with dot scales and plain rotating pointers, than with two more common formats, boxed digits and moving vertical tapes. R.E.P.

A92-11473

PREDICTION OF HELICOPTER SIMULATOR SICKNESS

ROGER D. HORN, J. D. BIRDWELL (Tennessee, University, Knoxville), and GLENN O. ALLGOOD (Oak Ridge National Laboratory, TN) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2380-2385. Research supported by Oak Ridge National Laboratory. Previously announced in STAR as N91-14710. refs
 (Contract NSF ECS-87-15092; DE-AC05-84OR-21400)
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Machine learning methods from artificial intelligence are used to identify information in sampled accelerometer signals and associative behavioral patterns which correlate pilot simulator sickness with helicopter simulator dynamics. In this work, accelerometers were installed in the simulator cab, enabling a complete record of the flight dynamics and the pilot's control response as a function of time. When given the results of performance measures administered to detect simulator sickness symptoms, the problem was to find functions of the recorded data which could be used to help predict the simulator sickness level and susceptibility. Methods based upon inductive inference were used, which yield decision trees whose leaves indicate the degree of simulator-induced sickness. The long-term goal is to develop a 'gauge' which can provide an online prediction of simulator sickness level when given a pilot's associative behavioral

patterns (learned expectations). This will allow informed decisions to be made on when to terminate a hop and provide an effective basis for determining the training and flight restrictions to be placed upon the pilot after simulator use. Author

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MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

A92-11153

CASE-BASED REASONING - TAMING THE SIMILARITY HEURISTIC

LESLIE A. WHITAKER (Dayton, University, OH), RICHARD H. STOTTLER, ANDREA HENKE (Stottler Henke Associates, Belmont, CA), and JAMES A. KING (NCR Corp., Dayton, OH) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 1. Santa Monica, CA, Human Factors Society, 1990, p. 312-315. Research supported by DARPA. refs (Contract DAAH01-88-C-0341)

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Case-based reasoning (CBR), a methodology for employing imprecise data and uncertain information in the development of solutions to fuzzy real world problems, is considered. A generic CBR shell has been developed. The system is evaluated in the domain of NACA airfoils. It is concluded that a computer can be used to assist in the development of satisfactory solutions for problems with uncertain data or no algorithmic rules. O.G.

A92-11180

ADVANCED TECHNOLOGY FOR AVIATION MAINTENANCE TRAINING - AN INDUSTRY STATUS REPORT AND DEVELOPMENT PLAN

WILLIAM B. JOHNSON (Galaxy Scientific Corp., Atlanta, GA) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1171-1175. Research supported by FAA. refs Copyright

This paper reports the status of a FAA project to support the application of advanced technology systems for aircraft maintenance training. The first phase of the research was to assess the current use of such technology in airlines, manufacturers and approved aviation maintenance technician schools. The findings of the assessment are reported. The second phase of the research will build a prototype intelligent tutoring system for aircraft maintenance training. The preliminary prototype specifications and rationale are discussed. Author

A92-11312

IEEE CONFERENCE ON DECISION AND CONTROL, 29TH, HONOLULU, HI, DEC. 5-7, 1990, PROCEEDINGS. VOLS. 1-6

Conference sponsored by IEEE. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. Vol. 1, 428 p.; vol. 2, 847 p.; vol. 3, 889 p.; vol. 4, 630 p.; vol. 5, 421 p.; vol. 6, 796 p. For individual items see A92-11313 to A92-11474, A92-11476 to A92-11527, A92-11529 to A92-11595.

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Various papers on decision and control are presented. The general topics addressed include: distributed parameter systems, robust stability, descriptor systems, robots, manufacturing systems, discrete event dynamic systems, control theory applications, $H(\infty)$ and robust control, linear nonlinear estimation, decision theory, adaptive control, stability of linear systems, linear elastic systems, implicit control systems, modeling and control, production planning, aircraft control in windshear, nonlinear observers and filtering, nonlinear feedback equivalence, queueing systems,

multivariable systems, identification. Also discussed are: nonlinear systems, nonlinear dynamics, communications networks, stochastic control, adaptive control, intelligent control systems, control applications in energy systems and the process industry, neural networks, linear control systems, digital control systems, active vehicle suspension systems, target tracking, flexible structure control, distributed detection and estimation, aerospace applications, nonlinear stabilization, adaptive estimation, descriptor and interconnected systems. C.D.

A92-11346

EXPERIMENTAL ACTIVE CONTROL OF A TWO-DIMENSIONAL TRUSS

CONSTANTINOS MINAS (GE Corporate Research and Development Center, Schenectady, NY) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 381-386. refs

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A flexible two-dimensional structure was actively controlled by using a single space realizable linear proof mass actuator. The NASA/UVA/UB actuator was attached to the flexible planar truss structure at an optimal location and it was considered as both a passive and an active device. The theoretical model of the system obtained by using the MSC/PAL package was modified so that it included the actuator dynamics. The theoretically predicted passive and active control law was experimentally verified. The electronic stiffness of the actuator was specified, such that the proof mass actuator system was tuned to the fourth structural mode of the truss by using traditional vibration absorber design for multiple degree-of-freedom systems. The active control law was experimentally implemented in the form of velocity feedback by integrating the signals of two accelerometers attached to the structure. The two lower modes of the closed-loop structure were placed further in the left-hand side of the complex plane. The stability of the closed-loop system was also examined. It was also illustrated experimentally that increasing the gains at higher than the optimal values drove the closed-loop system unstable, as it was theoretically predicted. I.E.

A92-11347

GAIN-SCHEDULED CONTROL OF NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS

ANTONI S. BANACH and WILLIAM T. BAUMANN (Virginia Polytechnic Institute and State University, Blacksburg) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 387-392. refs (Contract AF-AFOSR-89-0495)

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The conditions are presented under which a family of linear state-feedback controllers designed for a nonlinear distributed-parameter system can be pieced together to form an overall nonlinear controller. The resulting closed-loop system has the property that its linearizations are equal to the desired linearly-controlled systems. The idea of gain scheduling is considered for systems governed by nonlinear partial differential equations, such as systems involving fluid flow. It is shown that it is possible to apply this technique to finite-dimensional approximations to the original system and to obtain nonlinear feedback laws approximating the ideal controller. I.E.

A92-11351

ROBUSTNESS OF DISTRIBUTED SYSTEMS WITH RESPECT TO SMALL TIME DELAYS

RICHARD REBARBER (Nebraska, University, Lincoln) and GEORGE WEISS (Virginia Polytechnic Institute and State University, Blacksburg) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 408, 409. refs

(Contract AF-AFOSR-88-0076; AF-AFOSR-89-0031)

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Sufficient conditions are given for a stable distributed parameter feedback system with one dimensional input/output space to be destabilized by arbitrarily small time delays in the feedback loop. This result is applied to some vibrating systems. I.E.

A92-11356

A TIME APPROACH TO ROBUSTNESS OF LTI SYSTEMS WITH STRUCTURED UNCERTAINTY AND UNMODELLED DYNAMICS

K. M. SOBEL, J. E. PLOU, W. YU (City College, New York), E. Y. SHAPIRO (HR Textron, Inc., Valencia, CA), and R. WILSON (USAF, Armament Laboratory, Eglin AFB, FL) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 432, 433. refs
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A sufficient condition is obtained for the robust stability of a linear time-invariant plant with simultaneous time-varying structured state space uncertainty and unmodeled dynamics. The time-domain analysis results of robust constant gain output feedback are explicitly in terms of the closed-loop eigenvalues and eigenvectors and are well suited to the design of robust eigenstructure assignment controllers. I.E.

A92-11362

CLOSED-LOOP IDENTIFICATION AND ITERATIVE CONTROLLER DESIGN

KETAO LIU and ROBERT SKELTON (Purdue University, West Lafayette, IN) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 482-487. refs
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An iterative controller design scheme is presented which takes into account the inter-dependence of the modeling and controller design problems. This iterative scheme consists of closed-loop identification and controller redesign cycles. In each cycle, the plant model is identified in a closed-loop using the controller designed in the previous cycle. Then a new controller is redesigned by using the identified model. The iterative process continues until convergence. The q-Markov cover algorithm obtains system state-space models which have the same first q-Markov parameters and covariance parameters as the physical system generating the input-output data. At convergence the controller and the plant model are considered to be consistent. I.E.

A92-11363

REDUCED-ORDER ROBUST CONTROLLERS - H(INFINITY)-BALANCED TRUNCATION AND OPTIMAL PROJECTION

DENIS MUSTAFA (MIT, Cambridge, MA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 488-493. refs
(Contract AF-AFOSR-89-0276)
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Some insights are given regarding the H(infinity)-balanced truncation and optimal projection methods for reduced-order robust control. After a concise description of the optimal projection approach, it is shown how positive semidefiniteness of the Lagrange multiplier implies a minimized, not just extremized, auxiliary cost. When the results are specialized to the full-order case, it is observed that the apparently redundant fourth optimal projection equation has an important role to play, both in guaranteeing a minimized (not just extremized) auxiliary cost, and in removing nonminimal controller states. I.E.

A92-11375* Massachusetts Univ., Amherst.

STOCHASTIC ORDERING PROPERTIES AND OPTIMAL ROUTING CONTROL FOR A CLASS OF FINITE CAPACITY QUEUEING SYSTEMS

DON TOWSLEY, PANAYOTIS D. SPARAGGIS, and CHRISTOS G. CASSANDRAS (Massachusetts University, Amherst) IN: IEEE

Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 658-663. refs
(Contract N00014-87-K-0304; NSF ECS-88-01912; NAG2-595)
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The problem of routing jobs to parallel queues with identical exponential servers and unequal finite buffer capacities is considered. Stochastic ordering and weak majorization properties on critical performance measures are established by means of event-driven inductions. In particular, it is shown that the intuitive 'join the shortest non-full queue' (SNQ) policy is optimal with respect to an overall function that accounts for holding and blocking costs. Moreover, the buffer allocation problem is solved by proving the intuitive result that, for a fixed total buffer capacity, the optimal allocation scheme is the one in which the difference between the maximum and minimum queue capacities is minimized, i.e., becomes either 0 or 1. I.E.

A92-11376* Ohio State Univ., Columbus.

OPTIMAL STABILIZATION OF DISCRETE EVENT SYSTEMS

KEVIN M. PASSINO (Ohio State University, Columbus) and PANOS J. ANTSAKLIS (Notre Dame, University, IN) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 670, 671. Research supported by JPL. refs
Copyright

An optimal stabilization problem for discrete event systems (DES) is addressed. A class of not necessarily finite state 'logical' DES models is utilized which can also model the costs for events to occur. Let P and A denote two such models. Suppose that P characterizes the valid behavior of a dynamical system and A represents certain design objectives which specify the allowable DES behavior which is 'contained in' the valid behavior. An optimal control problem for P and A is how to choose the sequence of inputs to P so that the DES behavior lies in A (i.e., it is allowable) and so that a performance index defined in terms of the costs of the events is minimized. Two solutions are provided to an optimal stabilization problem, i.e. how to find a sequence of inputs that results in an optimal state trajectory which cycles in a pre-specified set. I.E.

A92-11377

A NEW STUDY ON A CLASS OF DISCRETE EVENT DYNAMIC SYSTEMS

XIAOQING FANG, XINGANG CHENG, and YINGPING ZHENG (Chinese Academy of Sciences, Institute of Automation, Beijing, People's Republic of China) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 680, 681. refs
Copyright

A method of discrete field (Euler) description is proposed to analyze a discrete-event dynamic system. Steady-state probability distribution of the system can be obtained. Modification of the model leads to the Lagrange description of system models, by which a closed-form solution for sojourn time can be derived. These computable models show their potential in application to the on-line control and optimization of discrete-event systems. It should be noted that the number of equations of the mathematical model is $(2 \times N_1 - 1) + N_2$, where N_1 is the number of operations and N_2 is the number of buffer units. The number of equations increases approximately in linear proportion to the number of space units, which shows the computability of the models presented. I.E.

A92-11381* Princeton Univ., NJ.

STOCHASTIC PREDICTION TECHNIQUES FOR WIND SHEAR HAZARD ASSESSMENT

D. A. STRATTON and ROBERT F. STENGEL (Princeton University, NJ) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of

Electrical and Electronics Engineers, Inc., 1990, p. 702-707. refs
(Contract NAG1-834)
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The threat of low-altitude wind shear has prompted development of aircraft-based sensors that measure winds directly on the aircraft's intended flight path. Measurements from these devices are subject to turbulence inputs and measurement error, as well as to the underlying wind profile. Stochastic estimators are developed to process on-board Doppler sensor measurements, producing optimal estimates of the winds along the path. A stochastic prediction technique is described to predict the hazard to the aircraft from the estimates as well as the level of uncertainty of the hazard prediction. The stochastic prediction technique is demonstrated in a simulated microburst wind shear environment. Use of the technique in a decision-making process is discussed.

I.E.

A92-11391**OBSERVABILITY ANALYSIS OF PIECE-WISE CONSTANT SYSTEMS WITH APPLICATION TO INERTIAL NAVIGATION**

I. Y. BAR-ITZHACK (Technion - Israel Institute of Technology, Haifa) and D. GOSHEN-MESKIN IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 821-826. refs

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A method for analyzing the observability of time-varying linear systems which can be modeled as piecewise constant systems is presented. An observability matrix for such systems is developed for continuous and discrete time representations. A stripped observability matrix is introduced which simplifies the analysis in cases where the use of this matrix is legitimate. This approach circumvents the difficulty associated with the investigation of the observability Gramian of time-varying linear systems. It is shown that instead of investigating a Gramian, only a constant observability matrix needs to be investigated. Moreover, it is shown that if certain conditions on the null space of the dynamics matrix of the system are met, the observability matrix can be greatly simplified. A step-by-step observability analysis procedure is presented for this case. The method is applied to the analysis of in-flight alignment of inertial navigation systems whose estimability is known to be enhanced by maneuvers. The analysis lays the theoretical background to, and clearly demonstrates the observability enhancement of, in-flight alignment. The analytic conclusions are confirmed by covariance simulations. The analysis yields interesting practical conclusions and a procedure hitherto unknown.

I.E.

A92-11395* Massachusetts Univ., Amherst.**A NEW CLASS OF GRADIENT ESTIMATORS FOR QUEUEING SYSTEMS WITH REAL-TIME CONSTRAINTS**

WEI-BO GONG, CHRISTOS G. CASSANDRAS, MICHELLE H. KALLMES (Massachusetts, University, Amherst), and YORAI WARDI (Georgia Institute of Technology, Atlanta) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 891-896. Research supported by U.S. Navy. refs

(Contract NSF ECS-88-01912; NAG2-595)

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Queueing systems are considered where the waiting or sojourn times of customers are constrained by specified deadlines. A performance measure of interest in these systems is the probability that a customer exceeds its assigned deadline. A new class of gradient estimators is presented for such performance measures with respect to various system parameters. The approach is applicable to a general class of problems and is based on efficiently capturing sensitivity information for probabilities of event occurrences from observed sample paths.

I.E.

A92-11417**ROBUST POLE ASSIGNMENT USING CLOSED LOOP CONTROLLABILITY CONDITIONS**

MIN-I J. CHANG (General Dynamics Corp., San Diego, CA) IN:

IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1061-1064. refs
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The problem of optimal selection of closed loop eigenvalues for single input systems is discussed. The elements of the closed-loop system mode controllability matrix (controllability condition) are used to design robust closed-loop systems. The main result shows that a robust closed loop system can be obtained by choosing closed-loop eigenvalues with minimal absolute value mode controllability elements. A criterion for the selection of robust closed-loop eigenvalues is provided. This criterion assures that the desired closed-loop system has low sensitivity to the variation of feedback gain, state estimate errors, or measurement errors.

I.E.

A92-11418**POLYGON INTERVAL ARITHMETIC AND DESIGN OF ROBUST CONTROL SYSTEMS**

YUZO OHTA, LEI GONG, and HIROMASA HANEDA (Kobe University, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1065-1067. refs

(Contract MOESC-6355031)

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Robust stability analysis and the robust controller design problem of multivariable control systems are considered. To represent and treat the uncertainty of frequency response of plants and controllers, a notion of polygon interval arithmetic (PIA) is introduced. By using PIA, the robust stability problem is solved more efficiently than the method based on the mapping theorem. Moreover, by using PIA, a robust sequential return difference (RSRD) method is proposed, which is an improved version of the traditional SRD method in the sense that it can treat uncertainty contained in both plants and controllers, and that it is possible to guarantee integrity if it is desired.

I.E.

A92-11420**DESIGN OF RELIABLE CONTROL SYSTEMS**

R. J. VEILLETTE, J. V. MEDANIC, and W. R. PERKINS (Illinois, University, Urbana) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1131-1136. Research supported by USAF and Sundstrand Corp. refs

(Contract N00014-90-J-1270)

Copyright

A methodology for the design of reliable control systems is developed. The resulting control systems are reliable in that they remain stable and provide guaranteed $H(\infty)$ performance despite sensor or actuator outages in the centralized case, or despite control-channel outages in the decentralized case. Reliability is guaranteed provides these outages occur within a prespecified subset of control components. Strongly stabilizing designs are also developed.

I.E.

A92-11426**A MULTIBODY ANALOG OF THE DUAL-SPIN PROBLEM**

LI-SHENG WANG and P. S. KRISHNAPRASAD (Maryland, University, College Park) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1294-1299. Research supported by U.S. Army. refs
(Contract AF-AFOSR-87-0073; AF-AFOSR-90-0105; NSF CDR-88-03012)

Copyright

A version of the Euler-Lagrange equation for motions on the special orthogonal group $SO(3)$ is established from the invariant form of the Lagrange-D'Alembert principle. This scheme can be used to derive dynamical equations for many-rigid-body problems. It can also be applied to certain continuum mechanical problems, e.g., the special Cosserat rod. The method is applied to a multibody

analog of the classical dual-spin problem and the dynamical equations are obtained. It is then shown that, with a suitable damping mechanism on one body and on the joint, an asymptotic stability theorem can be proved by using the LaSalle invariance principle. The driven rotor momenta are shown to play an important role in attitude acquisition. I.E.

A92-11427**A HORIZON-RECURSIVE FORM FOR PREDICTORS AND THEIR COMPUTATION**

YANG DONG and HOWARD J. CHIZECK (Case Western Reserve University, Cleveland, OH) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1481-1486. refs
Copyright

A simple, horizon-recursive expression for output predictors is obtained for both SISO (single-input single-output) and MIMO (multiple-input multiple-output) systems described by ARMAX models. This expression reveals that the predictors for the different prediction horizons are recursively related by a key parameter vector. Thus, by recursively computing this key parameter vector, an efficient algorithm for generating predictors is obtained. It shows certain advantages over methods involving recursive solving of Diophantine equations. I.E.

A92-11429**ON-LINE STATE ESTIMATION AND PARAMETER IDENTIFICATION FOR FLIGHT**

ZHONG-KE SHI (Northwestern Polytechnical University, Xian, People's Republic of China) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1559, 1560.
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A practical method for real-time flight-state estimation and aerodynamic-coefficient identification for aircraft is introduced. In order to achieve high accuracy, a discrete-time model for flight is presented. This model can offer hierarchical structures by means of which a faster real-time filtering algorithm is achieved. For the identification of aerodynamic coefficients, a recursive maximum likelihood method is presented which is suitable for flight regimes at low and high angles of attack. The results of simulation and computation show that the outputs of real-time flight state estimation are much more accurate than those calculated directly from noisy measurements. I.E.

A92-11430**H(INFINITY) CONTROL OF LINEAR SYSTEMS WITH NONZERO INITIAL CONDITIONS**

PRAMOD P. KHARGONEKAR (Michigan, University, Ann Arbor), KRISHAN M. NAGPAL, and KAMESHWAR R. POOLLA (Illinois, University, Urbana) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1821-1826. Research supported by Honeywell, Inc., McDonnell Douglas Corp., and Rockwell International Corp. refs
(Contract NSF ECS-90-96109; NSF ECS-89-57461; AF-AFOSR-90-0053; DAAL03-90-G-0008)
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In $H(\infty)$ (or uniformly optimal) control problems, it is usually assumed that the system initial conditions are zero. In the present work, the authors formulate an $H(\infty)$ -like control problem that incorporates uncertainty in initial conditions. This is done by defining a worst-case performance measure. Both finite and infinite horizon problems are considered. Necessary and sufficient conditions are derived for the existence of controllers that yield a closed-loop system for which the above-mentioned performance measure is less than a prespecified value. State-space formulae for the controllers are also presented. I.E.

A92-11431**DESIGN OF NON-OVERSHOOTING FEEDBACK CONTROL SYSTEMS**

GIRISH DEODHARE and M. VIDYASAGAR (Centre for Artificial Intelligence and Robotics, Bangalore, India) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1827-1834. refs
(Contract NSERC-A-1240)
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The authors consider the problem of designing non-overshooting feedback control systems when the input is a step. They also consider the more general problem of designing controllers to optimally track a step with some predetermined amount of allowable overshoot. It is shown that both these problems always have a solution (under some standard assumptions). It is then shown that the counterpart of this problem, that is, the problem of designing non-undershooting feedback control systems, need not have a solution in general, but it is proved that one can always design a feedback controller to achieve as little percentage of undershoot as desired. Most of the work deals with discrete-time single-input single-output (SISO) systems though some extensions of the techniques to continuous-systems are discussed. I.E.

A92-11442* Harris Government Aerospace Systems Div., Melbourne, FL.

EXPERIMENTAL DEMONSTRATION OF ACTIVE VIBRATION CONTROL FOR FLEXIBLE STRUCTURES

DOUGLAS J. PHILLIPS, DAVID C. HYLAND, and EMMANUEL G. COLLINS, JR. (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2024-2029. refs
(Contract F49620-87-C-0108; NAS1-18872)
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Active vibration control of flexible structures for future space missions is addressed. Three experiments that successfully demonstrate control of flexible structures are described. The first is the pendulum experiment. The structure is a 5-m compound pendulum and was designed as an end-to-end test bed for a linear proof mass actuator and its supporting electronics. Experimental results are shown for a maximum-entropy/optimal-projection controller designed to achieve 5 percent damping in the first two pendulum modes. The second experiment was based upon the Harris Multi-Hex prototype experiment (MHPE) apparatus. This is a large optical reflector structure comprising a seven-panel array and supporting truss which typifies a number of generic characteristics of large space systems. The third experiment involved control design and implementation for the ACES structure at NASA Marshall Space Flight Center. The authors conclude with some remarks on the lessons learned from conducting these experiments. I.E.

A92-11444**ROBUST STABILIZATION WITH POSITIVE REAL UNCERTAINTY - BEYOND THE SMALL GAIN THEOREM**

WASSIM M. HADDAD (Florida Institute of Technology, Melbourne) and DENNIS S. BERNSTEIN (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2054-2059. refs
(Contract F49620-89-C-0011; F49620-89-C-0029)
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The properties of positive real transfer functions are used to guarantee robust stability in the presence of positive real (but otherwise unknown) plant uncertainty. These results are then used for controller synthesis to address the problem of robust stabilization in the presence of positive real uncertainty. One of the principal motivations for these results is to utilize phase information in guaranteeing robust stability. In this sense these results go beyond the usual limitations of the small gain theorem

and quadratic Liapunov functions, which may be conservative when phase information is available. The results of this study are based upon a Riccati equation formation of the positive real lemma and thus are in the spirit of recent Riccati-based approaches to bounded real (H -infinity) control. I.E.

A92-11445

CONTROL DESIGN VIA TAM AND H-INFINITY APPROACHES - A FLEXIBLE BEAM CASE STUDY

T. S. TANG and G. M. HUANG (Texas A & M University, College Station) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2060, 2061. Research supported by Texas Advanced Research Program. refs
Copyright

The target approximation method (TAM) and H -infinity control theory are used to design robust vibration control of a flexible beam. The beam dynamics are approximated by a few lower order vibration modes of the beam. The remaining modes are treated as a modeling error. In the closed-loop system the uncontrolled and controlled modes interact through the control and observation spillovers, which cause a degraded system performance. The TAM solves the problem in the time domain by designing gains and actuator and sensor locations such that the closed-loop system imitates a target which has no spillovers. The H -infinity approach tackles the problem in the frequency domain by designing a controller which attenuates a class of disturbing signals, including the disturbance generated by the uncontrolled modes. The TAM always gives a lower order controller than the H -infinity approach. The H -infinity approach might not be a good solution for the spillover effect minimization problem when the controller can only have a low-order estimator. The H -infinity gains are much greater than the TAM gains. This implies that the H -infinity controller consumes more power than the TAM controller. I.E.

A92-11453

FAULT TOLERANT CONTROL BASED ON A NEW ACCOMMODATION FILTER

BONG C. MOON (Samsung Data Systems Co., Ltd., Seoul, Republic of Korea) and ZEUNGNAM BIEN (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2155, 2156. refs
Copyright

A fault-tolerant control method based on a new accommodation filter is proposed. Using the filter's ability to estimate the actual failure deviations and the actual states under faulty conditions, the authors illustrate a fault-tolerant control under sensor and actuator failure in a noisy system with parameter ambiguities. Although this approach to fault-tolerant control uses only analytic redundancy based on a mathematical model, with no additional hardware, it is expected that the result of this study may be easily applied to fault-tolerant control systems with additional hardware. I.E.

A92-11454

A DESIGN OF CONTINUOUS-TIME MODEL REFERENCE ADAPTIVE CONTROL BASED ON A FUNCTION ESTIMATION OF PERIODICALLY TIME VARYING LINEAR SYSTEM

SEIICHI SHIN (Tsukuba, University, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2157-2162. refs
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The author presents a design for stable continuous-time model reference adaptive control based on function estimation of periodically time-varying linear systems with known variation period and unknown system degree. This control system uses a nonminimum representation of the controlled object, where the controlled object is combined with an observer, thus eliminating direct use of a state and a filter to compensate for the relative

degree of the controlled object. The controlled object should be uniformly observable, that is, observable in a finite interval of time. The observer and the filter are realized by convolution integrals in a finite span of time. Integral kernel functions of the observer are periodically time-varying functions with the same variation period as that of the controlled object; the representation consists of convolution integrals similar to those used in the observer. The global stability of the proposed adaptive control system is analyzed and a simple numerical simulation is performed for verification of the viability of the proposed control system. I.E.

A92-11455

NEW ROBUST ADAPTIVE CONTROL SYSTEM USING MULTIPLE REGULARIZATION PARAMETERS

H. OHMORI and A. SANO (Keio University, Yokohama, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2163-2169. refs
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The design of a discrete-time model reference robust adaptive control system for a plant in the presence of bounded disturbances is investigated. The system uses a robust adaptive algorithm with multiple regularization parameters. This algorithm belongs to the class of leaky integration methods; thus the designed regularization parameters correspond to sigma in the sigma-modification approach. It is shown how to determine these regularization parameters theoretically such that minimization of the parameter error is attained in the presence of the disturbances, and it is not necessary for the upper bound of the disturbances to be known a priori. Furthermore, persistent spanning is ensured, regardless of the size of the disturbance. I.E.

A92-11456* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

USING NEW AGGREGATION OPERATORS IN RULE-BASED INTELLIGENT CONTROL

HAMID R. BERENJI, YUNG-YAW CHEN (NASA, Ames Research Center; Sterling Federal Systems, Inc., Moffett Field, CA), and RONALD R. YAGER (Iona College, New Rochelle, NY) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2198-2203. refs
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A new aggregation operator is applied in the design of an approximate reasoning-based controller. The ordered weighted averaging (OWA) operator has the property of lying between the And function and the Or function used in previous fuzzy set reasoning systems. It is shown here that, by applying OWA operators, more generalized types of control rules, which may include linguistic quantifiers such as Many and Most, can be developed. The new aggregation operators, as tested in a cart-pole balancing control problem, illustrate improved performance when compared with existing fuzzy control aggregation schemes. I.E.

A92-11464* Massachusetts Inst. of Tech., Cambridge.

OPTIMAL REJECTION OF BOUNDED PERSISTENT DISTURBANCES IN PERIODIC SYSTEMS

MUNTER A. DAHLEH, PETROS G. VOUGLARIS, and LENA S. VALAVANI (MIT, Cambridge, MA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2300-2305. Research supported by Boeing Co. refs
(Contract DAAL03-86-K-0171; NSF ECS-88-10178; NAG2-297; F08635-87-K-0031)

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The problem of optimal rejection of bounded persistent disturbances is solved in the case of linear discrete-time period systems. The solution consists of solving an equivalent time-invariant standard H_1 optimization problem subject to an additional constraint. This constraint ensures the causality of the resulting periodic controller. By the duality theory, the problem is

shown to be equivalent to a linear programming problem, which is no harder than the standard l1 problem. I.E.

A92-11465**DYNAMIC INTERPOLATION FOR LINEAR SYSTEMS**

PETER E. CROUCH (Arizona State University, Tempe) and JOSEPH W. JACKSON (Honeywell Commercial Flight Systems Group, Glendale, AZ) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2312-2314. refs

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The authors set out to apply dynamic interpolation to a single-input, single-output (SISO) time-invariant linear system. Optimization of a quadratic cost function is embedded in the method to provide minimization of control effort. These results are applied to the guidance of a linearized aircraft model through a set of 4-D (spatial- and time-coordinate) 'waypoints' on final approach into an airport. In a practical implementation of this method, the interaction of an on-board flight management computer (FMS) and the microwave landing system (MLS) can be directed to generate smooth steering commands to either the pilot or autopilot. Actuation of such commands would result in a curved path trajectory through the desired waypoints. The proposed configuration was intended to increase air traffic control (ATC) efficiency by expanding the usage of the controlled airspace of the facility, resulting in reduced congestion at many major airports. I.E.

A92-11466**EQUIVALENCE OF OPTIMAL CONTROL PROBLEMS AND THE USE OF PARAMETERIZATION METHODS**

JOHN E. DZIELSKI (Pennsylvania State University, University Park) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2317, 2318. refs

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A notion of equivalence for optimal control synthesis problems is defined and partially characterized. If the dynamical constraint satisfies certain well-known conditions, a solution can be obtained by solving a related problem involving a linear constraint. The linearity can be exploited when using functional approximation techniques to obtain a solution. A class of interpolating polynomials is suggested that possess certain characteristics that make them useful when solving the equivalent problem by one of the mathematical programming methodologies. I.E.

A92-11467**A METHOD OF CENTERS BASED ON BARRIER FUNCTIONS FOR SOLVING OPTIMAL CONTROL PROBLEMS WITH CONTINUUM STATE AND CONTROL CONSTRAINTS**

E. POLAK, T. H. YANG (California, University, Berkeley), and D. Q. MAYNE (California, University, Davis; Imperial College of Science, Technology, and Medicine, London, England) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2327-2332. Research supported by State of California MICRO Program. refs

(Contract NSF ECS-87-13334; AF-AFOSR-86-0116)

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The authors describe a method of centers based on barrier functions for solving optimal control problems with continuum inequality constraints on the state and control. The method decomposes the original problem into a sequence of easily solved optimal control problems with control constraints only. The method requires only approximate solution of the problems. Two versions of a phase I-phase II method-of-centers-type algorithm are presented. Although, at first glance, the algorithms appear to have potential for failure owing to ill conditioning, preliminary computational results show that this is not so and in fact, that the algorithms are highly effective. I.E.

A92-11472**A NOVEL ASSOCIATIVE MEMORY FOR HIGH LEVEL CONTROL FUNCTIONS**

WEI K. TSAI (California, University, Irvine), ALEXANDER PARLOS, and BENITO FERNANDEZ (Texas A & M University, College Station) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2374-2379. refs

(Contract DE-FG07-89ER-12893)

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A novel associative memory (AM) knowledge base for real-time diagnostics and high-level control functions for complex large-scale dynamic systems is presented. The proposed AM architecture is called ASDM as it is an adaptive architecture based on the sparse distributed memory (SDM) first introduced by Kanerva. ASDM is proposed to overcome many limitations of SDM, while keeping most of the advantages of the original SDM. The new model is adaptive since the memory cells are renamed according to a learning/storing process. The analysis of the best match problem can be carried out in a deterministic setting. Also introduced is the concept of time-varying intensity of memory, and generalized metrics are used for determining distance between two data objects. One major application of this ASDM is that of a neural expert system. With the ASDM, the machine can 'learn' rules on top of the knowledge acquired from human experts. I.E.

A92-11553**AN APPROACH TO THE OPTIMAL OUTPUT FEEDBACK INITIAL STABILIZING GAIN PROBLEM**

JOHN R. BROUSSARD (Texas Instruments, Inc., Missile Systems Div., Lewisville) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2918-2920. refs

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The author presents an algorithm which can be started using a full state feedback gain and converges to an output feedback or decentralized output feedback gain which minimizes a quadratic cost function. The algorithm is obtained by solving an optimal control problem with feedback gain scalar equality constraints adjoined to a quadratic cost function. An example using the algorithm is presented for the design of a lateral autopilot using a limited set of onboard sensors. I.E.

A92-11583* Washington State Univ., Pullman.

DESIGN OF LOCALIZER CAPTURE AND TRACK HOLD FOR A TRANSFORM AIRPLANE - AN H(INFINITY)/LTR APPROACH

B. M. CHEN, A. SABERI (Washington State University, Pullman), UY-LOI LY (Washington, University, Seattle), and Y. S. EBRAHIMI (Boeing Commercial Airplanes, Seattle, WA) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 3349, 3350. Research supported by Boeing Commercial Airplane Group. refs

(Contract NAG2-629)

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The authors describe the design of a lateral track-hold control law in a localizer capture and track autopilot using a procedure based on H(infinity)-optimization and loop transfer recovery. The recovery of the achievable performance using output feedback from a satisfactory track-hold design obtained in an H(infinity)-optimization is demonstrated. Simulation for a lateral track command is presented along with robustness properties of the output feedback design. Results indicate that the recovery of achievable performance must be carefully traded-off against control bandwidth limitation. I.E.

A92-11587**STATE FEEDBACK FOR NONLINEAR CONTINUOUS-TIME SYSTEMS - STABILIZATION AND THE CREATION OF INVARIANT SUBSPACES**

JACOB HAMMER (Florida, University, Gainesville) IN: IEEE

Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 3390-3395. Research supported by NSF. refs
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A theory of static state feedback for multivariable continuous-time nonlinear systems is formulated. The theory applies to systems described by differential equations of the form $\dot{x}(t) = f(x(t), u(t))$. The basic objective is to design static state feedback compensators which achieve the following properties: (1) the state-space trajectory of the closed loop system is confined within a specified subspace, and (2) the closed-loop system is internally stable. An explicit method for designing such compensators is developed. The construction of the compensators involves only quantities directly derived from the given function. I.E.

A92-12367* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

PARALLEL COMPUTATION OF AERODYNAMIC INFLUENCE COEFFICIENTS FOR AEROELASTIC ANALYSIS ON A TRANSPUTER NETWORK

D. C. JANETZKE (NASA, Lewis Research Center, Cleveland, OH) and D. V. MURTHY (Toledo, University, OH) (Parallel methods on large-scale structural analysis and physics applications; Symposium, Hampton, VA, Feb. 5, 6, 1991, Selected Papers. A92-12351 02-61) Computing Systems in Engineering (ISSN 0956-0521), vol. 2, no. 2-3, 1991, p. 289-297. refs
Copyright

Aeroelastic analysis is multi-disciplinary and computationally expensive. Hence, it can greatly benefit from parallel processing. As part of an effort to develop an aeroelastic analysis capability on a distributed-memory transputer network, a parallel algorithm for the computation of aerodynamic influence coefficients is implemented on a network of 32 transputers. The aerodynamic influence coefficients are calculated using a three-dimensional unsteady aerodynamic model and a panel discretization. Efficiencies up to 85 percent are demonstrated using 32 processors. The effects of subtask ordering, problem size and network topology are presented. A comparison to results on a shared-memory computer indicates that higher speedup is achieved on the distributed-memory system. Author

N92-10347*# Brown Univ., Providence, RI. Div. of Engineering. **PARAMETER IDENTIFICATION FOR NONLINEAR AERODYNAMIC SYSTEMS Semiannual Progress Report No. 4, 24 Apr. - 22 Oct. 1991**

ALLAN E. PEARSON 1991 9 p
(Contract NAG1-1065)
(NASA-CR-188985; NAS 1.26:188985) Avail: NTIS HC/MF A02 CSCL 12/1

Work continues on frequency analysis for transfer function identification, both with respect to the continued development of the underlying algorithms and in the identification study of two physical systems. Some new results of a theoretical nature were recently obtained that lend further insight into the frequency domain interpretation of the research. Progress in each of those areas is summarized. Although not related to the system identification problem, some new results were obtained on the feedback stabilization of linear time lag systems. Author

N92-11642*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH. **COMPUTERS IN AERONAUTICS AND SPACE RESEARCH AT THE LEWIS RESEARCH CENTER**

1991 12 p Prepared in cooperation with Sverdrup Technology, Inc., Cleveland, OH
(NASA-TM-105096; NAS 1.15:105096) Avail: NTIS HC/MF A03; 3 functional color pages CSCL 09/2

This brochure presents a general discussion of the role of computers in aerospace research at NASA's Lewis Research Center (LeRC). Four particular areas of computer applications are addressed: computer modeling and simulation, computer assisted

engineering, data acquisition and analysis, and computer controlled testing. M.G.

N92-11706*# Draper (Charles Stark) Lab., Inc., Cambridge, MA. **ADVANCED INFORMATION PROCESSING SYSTEM: INTER-COMPUTER COMMUNICATION SERVICES**

LAURA BURKHARDT, TOM MASOTTO, J. TERRY SIMS, ROY WHITTREDGE, and LINDA S. ALGER Sep. 1991 340 p Original contains color illustrations
(Contract NAS1-18565)
(NASA-CR-187556; NAS 1.26:187556) Avail: NTIS HC/MF A15; 1 functional color page CSCL 09/2

The purpose is to document the functional requirements and detailed specifications for the Inter-Computer Communications Services (ICCS) of the Advanced Information Processing System (AIPS). An introductory section is provided to outline the overall architecture and functional requirements of the AIPS and to present an overview of the ICCS. An overview of the AIPS architecture as well as a brief description of the AIPS software is given. The guarantees of the ICCS are provided, and the ICCS is described as a seven-layered International Standards Organization (ISO) Model. The ICCS functional requirements, functional design, and detailed specifications as well as each layer of the ICCS are also described. A summary of results and suggestions for future work are presented. Author

N92-11737# Strathclyde Univ., Glasgow (Scotland). **INVERSE PROBLEMS AND IMAGING (PITMAN RESEARCH NOTES IN MATHEMATICS SERIES NUMBER 245)**

G. F. ROACH 1991 279 p
(Contract DAJA45-89-M-0086)
(AD-A240333; R/D-6105-MA-02) Avail: NTIS HC/MF A13 CSCL 12/1

Some topics of research are as follows: Partial Measurement and reconstruction in electrical impedance tomography; Polarization in electromagnetic inverse problems; Inverse thermoelastic Rayleigh scattering by a rigid ellipsoid; An inverse moving boundary problem for Laplace's equation; The scattering of velocity fields by an airfoil in compressible flow; and Boundary problems in electrical impedance tomography. GRA

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PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

A92-11052 **ACTIVE CONTROL OF SOUND TRANSMISSION THROUGH ELASTIC PLATES USING PIEZOELECTRIC ACTUATORS**

E. K. DIMITRIADIS and C. R. FULLER (Virginia Polytechnic Institute and State University, Blacksburg) AIAA Journal (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1771-1777. Previously cited in issue 13, p. 2049, Accession no. A89-33711. refs
(Contract N00014-88-K-0721)
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A92-11053* Continuum Dynamics, Inc., Princeton, NJ. **PREDICTION OF HIGH-RESOLUTION FLOWFIELDS FOR ROTORCRAFT AEROACOUSTICS**

TODD R. QUACKENBUSH (Continuum Dynamics, Inc., Princeton, NJ) and DONALD B. BLISS (Duke University, Durham, NC) AIAA Journal (ISSN 0001-1452), vol. 29, Nov. 1991, p. 1778-1786. refs
(Contract NAS1-18607)
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A new approach to the vortex wake of a helicopter is described. This approach makes it possible to obtain highly accurate resolution

of the flowfield experienced by the tail rotor with modest computational effort relative to alternative models. A full-span free wake model of the main rotor in a scheme is presented which reconstructs high resolution flow solutions from preliminary simulations with coarse resolution. A new reconstruction method uses local velocity correction terms to capture the steep velocity gradients characteristic of the the vortex-dominated incident flow. The approach is considered to be successful in capturing the high resolution flows necessary for analysis of rotor-wake/rotor interactions with substantially reduced computational cost. O.G.

A92-11281

POWER PERFORMANCE OF A NONISENTROPIC BRAYTON CYCLE

C. WU (U.S. Naval Academy, Annapolis, MD) and R. L. KIANG (U.S. Navy, David W. Taylor Naval Ship Research and Development Center, Annapolis, MD) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 113, Oct. 1991, p. 501-504. refs

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Work and power optimization of a Brayton cycle are analyzed with a finite-time heat transfer analysis. This work extends the recent flurry of publications in heat engine efficiency under the maximum power condition by incorporating nonisentropic compression and expansion. As expected, these nonisentropic progresses lower the power outputs as well as the cycle efficiency when compared with an endoreversible Brayton cycle under the same conditions. Author

A92-12345

ACOUSTIC ISOLATION OF LAYERS [IZOLACJA AKUSTYCZNA POWLOK]

DANIELJUS GUZAS (Wilenski Instytut Inżynierii Budowlanej, Poland) Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 124-125, 1991, p. 37-51. In Polish. refs

The theoretical basis of the isolation of layers is presented. Some nomenclature issues are discussed, and the difference between flat and curve layers is presented. Examples for thin layers are presented. Discussion is limited to low frequency which makes noise more difficult to overcome. The analysis concerns large-diameter and thin-walled pipes but also can be applied to small rooms with similar sections. The principles of the selection of resonant dampers with calculations are given. They can be used in aircraft cabin design. Author

N92-10598*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

AEROACOUSTICS OF FLIGHT VEHICLES: THEORY AND PRACTICE. VOLUME 1: NOISE SOURCES

HARVEY H. HUBBARD, ed. Washington Aug. 1991 601 p Sponsored in cooperation with Wright Research and Development Center and Army Aviation Systems Command (Contract F33615-84-C-3202) (NASA-RP-1258-VOL-1; L-16926-VOL-1; NAS 1.61:1258-VOL-1; WRDC-TR-90-3052-VOL-1) Avail: NTIS HC/MF A99 CSCL 20/1

Methodology recommended to evaluate aeroacoustic related problems is provided, and approaches to their solutions are suggested without extensive tables, nomographs, and derivations. Orientation is toward flight vehicles and emphasis is on underlying physical concepts. Theoretical, experimental, and applied aspects are covered, including the main formulations and comparisons of theory and experiment. The topics covered include: propeller and propfan noise, rotor noise, turbomachinery noise, jet noise classical theory and experiments, noise from turbulent shear flows, jet noise generated by large-scale coherent motion, airframe noise, propulsive lift noise, combustion and core noise, and sonic booms.

N92-10599*# Hamilton Standard, Windsor Locks, CT.

PROPELLER AND PROPFAN NOISE

B. MAGLIOZZI, D. B. HANSON, and R. K. AMIET (AMI, Wooster, OH.) In NASA. Langley Research Center, Aeroacoustics of Flight

Vehicles: Theory and Practice. Volume 1: Noise Sources p 1-64 Aug. 1991

Avail: NTIS HC/MF A99 CSCL 20/1

The characteristics of propellers, their noise-generating mechanisms, propeller noise theories and calculation procedures, and sound propagation effects are described. Comparisons of predictions and measurements, and means for controlling propeller noise are described. Author

N92-10600*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ROTOR NOISE

F. H. SCHMITZ In NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 65-149 Aug. 1991

Avail: NTIS HC/MF A99 CSCL 20/1

The physical characteristics and sources of rotorcraft noise as they exist today are presented. Emphasis is on helicopter-like vehicles, that is, on rotorcraft in nonaxial flight. The mechanisms of rotor noise are reviewed in a simple physical manner for the most dominant sources of rotorcraft noise. With simple models, the characteristic time- and frequency-domain features of these noise sources are presented for idealized cases. Full-scale data on several rotorcraft are then reviewed to allow for the easy identification of the type and extent of the radiating noise. Methods and limitations of using scaled models to test for several noise sources are subsequently presented. Theoretical prediction methods are then discussed and compared with experimental data taken under very controlled conditions. Finally, some promising noise reduction technology is reviewed. Author

N92-10601*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TURBOMACHINERY NOISE

JOHN F. GROENEWEG, THOMAS G. SOFRIN, EDWARD J. RICE, and PHILLIP R. GLIEBE (General Electric Co., Cincinnati, OH.) In NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 151-209 Aug. 1991

Avail: NTIS HC/MF A99 CSCL 20/1

Summarized here are key advances in experimental techniques and theoretical applications which point the way to a broad understanding and control of turbomachinery noise. On the experimental side, the development of effective inflow control techniques makes it possible to conduct, in ground based facilities, definitive experiments in internally controlled blade row interactions. Results can now be valid indicators of flight behavior and can provide a firm base for comparison with analytical results. Inflow control coupled with detailed diagnostic tools such as blade pressure measurements can be used to uncover the more subtle mechanisms such as rotor strut interaction, which can set tone levels for some engine configurations. Initial mappings of rotor wake-vortex flow fields have provided a data base for a first generation semiempirical flow disturbance model. Laser velocimetry offers a nonintrusive method for validating and improving the model. Digital data systems and signal processing algorithms are bringing mode measurement closer to a working tool that can be frequently applied to a real machine such as a turbofan engine. On the analytical side, models of most of the links in the chain from turbomachine blade source to far field observation point have been formulated. Three dimensional lifting surface theory for blade rows, including source noncompactness and cascade effects, blade row transmission models incorporating mode and frequency scattering, and modal radiation calculations, including hybrid numerical-analytical approaches, are tools which await further application. Author

N92-10602*# Southampton Univ. (England).

JET NOISE CLASSICAL THEORY AND EXPERIMENTS

G. M. LILLEY In NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 211-289 Aug. 1991

Avail: NTIS HC/MF A99 CSCL 20/1

Lighthill's theory of aerodynamic noise is presented as the foundation on which to build all other theories of aerodynamic noise. The application of the Lighthill acoustic analogy to the estimation of the characteristics of the noise radiated from the jets is central. Attention is given to the assumptions on which the Lighthill acoustic analogy is based and it is shown why the theory gives results different from experiment when flow-acoustic interaction occurs. The details of flow-acoustic interaction are invariably unavailable to provide the necessary fine adjustments to the Lighthill source function to render it such that the noise radiation as calculated is exact. The alternative approaches to the understanding of aerodynamic noise theory are discussed. The emphasis is placed on the flow-acoustic interaction and such theories as are required to complement the results obtained by application of Lighthill's acoustic analogy. The authors discuss some of the dominant features of the mean flow and the turbulent structure of a jet as a guide to modeling the T sub ij four-order covariance, which is central to applications involving Lighthill's acoustic analogy. The results obtained from the acoustic analogy model are compared with experimental data obtained by application of the polar correlation technique to both a model-scale jet and a full-scale jet engine. The relatively close agreement is evidence that the flow field data are pertinent to the description of the acoustic analogy model. A brief description is given of attempts to reduce jet noise without incurring an undue penalty in the loss of nozzle efficiency. Finally, the importance of good, reliable, and accurate experimental data in all studies of aerodynamic noise is stressed. Author

N92-10603*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

NOISE FROM TURBULENT SHEAR FLOWS

M. E. GOLDSTEIN /in NASA. Langley Research Center, Aerodynamics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 291-310 Aug. 1991
Avail: NTIS HC/MF A99 CSCL 20/1

The generation of sound in turbulent shear flows with high Reynolds numbers is discussed. Solid surface effects, representation of incident turbulence, sound generation and the role of instability waves, sound generation by turbulence interacting with itself (the jet noise problem), compressible Rayleigh equations, sound generation from streamwise variations in mean flow, complex turbulent flows, and supersonic flows are among the topics discussed. Author

N92-10604*# Florida State Univ., Tallahassee.

JET NOISE GENERATED BY LARGE-SCALE COHERENT MOTION

CHRISTOPHER K. W. TAM /in NASA. Langley Research Center, Aerodynamics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 311-390 Aug. 1991
Avail: NTIS HC/MF A99 CSCL 20/1

The noise generated by large scale turbulence structures and instability waves of jets is discussed. Emphasis is placed on supersonic jets with moderate to high Reynolds numbers. This is because it is in these jets that unambiguous experimental and theoretical evidence is found indicating that large turbulence structures and instability waves are directly responsible for generating the dominant part of the noise. For subsonic jets similar large turbulence structures and instability waves do play a crucial role in the dynamics, spread, and mixing of the jet fluid. However, at subsonic convection speeds, they do not appear to be efficient noise generators. Many investigators believe that the dominant noise source of subsonic jets is, in fact, the small scale turbulence. As yet, this belief has not yet received universal acceptance. The issues involved are complicated and are not easy to resolve. Author

N92-10605*# Cambridge Univ. (England).

AIRFRAME NOISE

DAVID G. CRIGHTON /in NASA. Langley Research Center, Aerodynamics of Flight Vehicles: Theory and Practice. Volume 1:

Noise Sources p 391-447 Aug. 1991

Avail: NTIS HC/MF A99 CSCL 20/1

Current understanding of airframe noise was reviewed as represented by experiment at model and full scale, by theoretical modeling, and by empirical correlation models. The principal component sources are associated with the trailing edges of wing and tail, deflected trailing edge flaps, flap side edges, leading edge flaps or slats, undercarriage gear elements, gear wheel wells, fuselage and wing boundary layers, and panel vibration, together with many minor protrusions like radio antennas and air conditioning intakes which may contribute significantly to perceived noise. There are also possibilities for interactions between the various mechanisms. With current engine technology, the principal airframe noise mechanisms dominate only at low frequencies, typically less than 1 kHz and often much lower, but further reduction of turbomachinery noise in particular may make airframe noise the principal element of approach noise at frequencies in the sensitive range. Author

N92-10606*# Norden, Norwalk, CT.

PROPULSIVE LIFT NOISE

MARTIN R. FINK /in NASA. Langley Research Center, Aerodynamics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 449-481 Aug. 1991
Avail: NTIS HC/MF A99 CSCL 20/1

Propulsive life noise is the increase in noise that occurs when airframe surfaces are placed in the propulsive system's exhaust to increase their lift force. Increased local flow velocities and turbulence levels, due to the propulsive system exhaust gases passing along the airframe lifting surfaces, cause an increase in maximum lift coefficient. The airplane's flight speed required for takeoff and landing can then be significantly reduced, allowing operation from shorter runways than those of conventional commercial airports. Unfortunately, interaction of high velocity turbulent exhaust flow with the airframe's solid surfaces generates additional noise radiation. Aeroacoustic processes that cause propulsive lift noise also are present in airframe noise and propulsive system installation noise. Research studies of propulsive lift noise led to development of improved methods of predicting noise radiation from surfaces in turbulent flows. Noise reduction and prediction methods of aircraft noise are discussed. Author

N92-10607*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMBUSTION AND CORE NOISE

J. ROBERT MAHAN (Virginia Polytechnic Inst. and State Univ., Blacksburg.) and ALLEN KARCHMER /in NASA. Langley Research Center, Aerodynamics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 483-517 Aug. 1991
Avail: NTIS HC/MF A99 CSCL 20/1

Two types of aircraft power plant are considered: the gas turbine and the reciprocating engine. The engine types considered are: the reciprocating engine, the turbojet engine, the turboprop engine, and the turbofan engine. Combustion noise in gas turbine engines is discussed, and reciprocating-engine combustion noise is also briefly described. The following subject areas are covered: configuration variables, operational variables, characteristics of combustion and core noise, sources of combustion noise, combustion noise theory and comparison with experiment, available prediction methods, diagnostic techniques, measurement techniques, data interpretation, and example applications. Author

N92-10608*# Eagle Engineering, Inc., Hampton, VA.

SONIC BOOM

DOMENIC J. MAGLIERI and KENNETH J. PLOTKIN (Wyle Labs., Inc., Arlington, VA.) /in NASA. Langley Research Center, Aerodynamics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 519-561 Aug. 1991
Avail: NTIS HC/MF A99 CSCL 20/1

A status of the knowledge of sonic booms is provided, with emphasis on their generation, propagation and prediction. For completeness, however, material related to the potential for sonic boom alleviation and the response to sonic booms is also included.

The material is presented in the following sections: (1) nature of sonic booms; (2) review and status of theory; (3) measurements and predictions; (4) sonic boom minimization; and (5) responses to sonic booms. Author

N92-11758*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ANNOYANCE CAUSED BY ADVANCED TURBOPROP AIRCRAFT FLYOVER NOISE: COMPARISON OF DIFFERENT PROPELLER CONFIGURATIONS

DAVID A. MCCURDY Washington Oct. 1991 69 p
(NASA-TP-3104; L-16850; NAS 1.60:3104) Avail: NTIS HC/MF A04 CSCL 20/1

A laboratory experiment was conducted to compare the annoyance of flyover noise from advanced turboprop aircraft having different propeller configurations with the annoyance of conventional turboprop and turbofan aircraft flyover noise. A computer synthesis system was used to generate 40 realistic, time varying simulations of advanced turboprop takeoff noise. Of the 40 noises, single-rotating propeller configurations (8) and counter-rotating propeller configurations with an equal (12) and unequal (20) number of blades on each rotor were represented. Analyses found that advanced turboprops with single-rotating propellers were, on average, slightly less annoying than the other aircraft. Fundamental frequency and tone-to-broadband noise ratio affected annoyance response to advanced turboprops, but the effects varied with propeller configuration and noise metric. The addition of duration corrections and corrections for tones above 500 Hz to the noise measurement procedures improved annoyance prediction ability. Author

N92-11759*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A NEW SIMULATOR FOR ASSESSING SUBJECTIVE EFFECTS OF SONIC BOOMS

JACK D. LEATHERWOOD, KEVIN P. SHEPHERD, and BRENDA M. SULLIVAN (Lockheed Engineering and Sciences Co., Hampton, VA.) Sep. 1991 34 p
(NASA-TM-104150; NAS 1.15:104150) Avail: NTIS HC/MF A03 CSCL 20/1

A man rated and computer driven sonic boom simulator which has been constructed and placed in operational use at NASA-Langley is described. The simulator is used to study human subjective reactions to sonic booms and has the capability of producing a wide range of signatures under controlled conditions. Results are presented to illustrate the capability of the simulator to generate user specified N-wave and shaped booms having rise times as low as 0.5 milliseconds and peak overpressures up to 191 Pa (4 psf). The validity of the simulator as a lab research tool for studying human subjective response to sonic booms was demonstrated by successful completion of a preliminary test designed to compare loudness of N-wave sonic booms with results obtained by other investigators. Excellent agreement of the preliminary test data with existing data was observed. This provided confidence in the experimental methodology and established the simulator as a viable tool for performing detailed evaluations of sonic boom loudness and acceptability within the lab. environment. Author

N92-11765*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A LOUDNESS CALCULATION PROCEDURE APPLIED TO SHAPED SONIC BOOMS

KEVIN P. SHEPHERD and BRENDA M. SULLIVAN (Lockheed Engineering and Sciences Co., Hampton, VA.) Washington Nov. 1991 13 p
(NASA-TP-3134; L-16913; NAS 1.60:3134) Avail: NTIS HC/MF A03 CSCL 20/1

Described here is a procedure that can be used to calculate the loudness of sonic booms. The procedure is applied to a wide range of sonic booms, both classical N-waves and a variety of other shapes of booms. The loudness of N-waves is controlled by overpressure and the associated rise time. The loudness of

shaped booms is highly dependent on the characteristics of the initial shock. A comparison of the calculated loudness values indicates that shaped booms may have significantly reduced loudness relative to N-waves having the same peak overpressure. This result implies that a supersonic transport designed to yield minimized sonic booms may be substantially more acceptable than an unconstrained design. Author

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SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

A92-11214

LEGAL PROBLEMS IN AIRCRAFT TOWING USING THE PTS PROCEDURE [RECHTSPROBLEME BEIM FLUGZEUGSCHLEPP NACH DEM PTS-VERFAHREN]

ELMAR GIEMULLA and RONALD SCHMID Zeitschrift fuer Luft- und Weltraumrecht (ISSN 0340-8329), vol. 40, Sept. 1991, p. 269-275. In German. refs

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The nature of the responsible party during aircraft towing using the Plane Transport System (PTS) is examined. Whether that party can be seen as a pilot is considered. C.D.

A92-11215

REGISTRATION OF AIRCRAFT IN THE AIRCRAFT REGISTRAR USING THE 'LEASING DECREE' OF THE FEDERAL MINISTER OF TRANSPORT OF FEBRUARY 12, 1991 [DIE REGISTRIERUNG VON LUFTFAHRZEUGEN IN DER LUFTFAHRZEUGROLLE NACH DEM 'LEASINGERLASS' DES BUNDESMINISTERS FUER VERKEHR VON 12. FEBRUAR 1991]

THOMAS WENZLER Zeitschrift fuer Luft- und Weltraumrecht (ISSN 0340-8329), vol. 40, Sept. 1991, p. 276, 277. In German. refs

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The law covering registration of aircraft in Germany is briefly reviewed. Attention is given to the procedure for registering leased aircraft. C.D.

A92-12700#

DEVELOPING UNDERGRADUATE GAS TURBINE AND TURBOMACHINERY COURSES

JACK D. MATTINGLY (Seattle University, WA) AIAA, SAE, and ASME, Joint Propulsion Conference, 27th, Sacramento, CA, June 24-26, 1991. 17 p. refs
(AIAA PAPER 91-2509) Copyright

Seattle University is involved in developing new engineering courses because of its focus on teaching and small size. This paper presents a recent experience in developing two undergraduate courses in mechanical engineering: a gas turbine engine course and a turbomachinery course. To enhance the learning process, each course has a comprehensive design problem. Curriculum development, course contents, course materials, and example design problems are highlighted. Also discussed are the newly developed course materials and personal computer software. Author

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GENERAL

N92-11963# Office National d'Etudes et de Recherches
Aerospatiales, Paris (France).

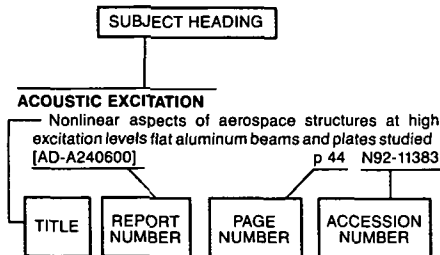
**EIGHTY YEARS OF AEROSPACE TECHNIQUE THROUGH
ATMA BULLETINS [80 ANS DE TECHNIQUE AEROSPATIALE
A TRAVERS LES BULLETINS DE L'ATMA]**

J.-P. MAREC 1990 123 p In FRENCH; ENGLISH summary
(ETN-91-90097) Avail: NTIS HC/MF A06

The history of aerospace techniques during the last 80 years is reviewed from the rapid analysis of the memoirs presented at the sessions of ATMA (French acronym for the French association of maritime and aeronautical techniques) during this period. The main headings reviewed are: aerodynamics and hydrodynamics, flight mechanics, structures and materials, equipment, navigation, different types of vehicles, engines, aerospace programs and miscellaneous problems including safety. Some particularly significant passages of the memoirs are quoted and the text is abundantly illustrated by figures taken from the memoirs. A chronological index and an analytical index of the memoirs are given as appendices.

ESA

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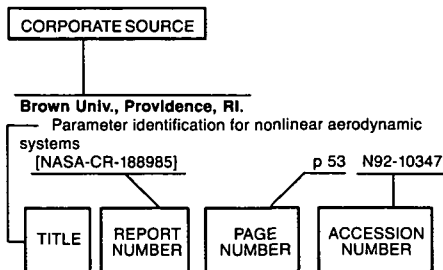
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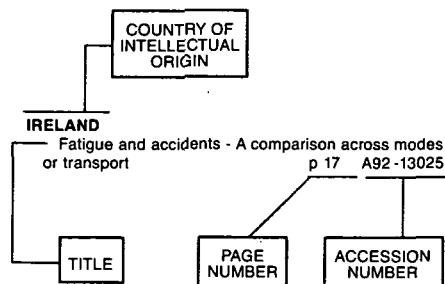
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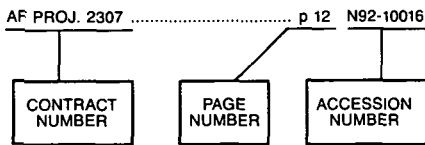
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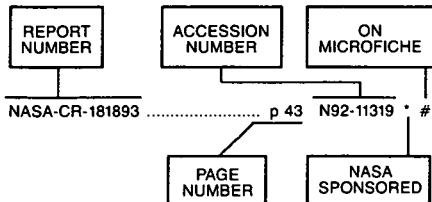
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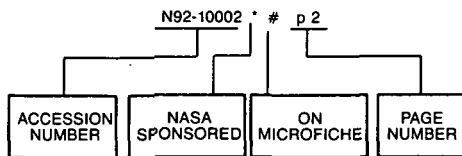
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